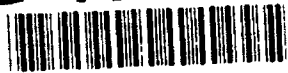


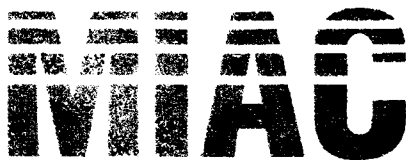
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Bibliography on Hot Isostatic Pressing (HIP) Technology

B. F. Gilp
P. D. Desai
J. F. Radavich
C. Y. Ho

November 1992

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13. ABSTRACT (Maximum 200 words) This report contains an annotated bibliography of 950 documents on the Hot Isostatic Pressing (HIP) Technology dealing with metals, alloys, and intermetallic compounds and covers over 450 materials. Documents published from 1966 to early 1992 are covered. Bibliographic information reported here are divided into three broad categories. The first category includes an annotated bibliography dealing with HIP technology as applied to powder metallurgy. The second category deals with casting and the third deals with miscellaneous materials which either are not properly identified or have a limited number of bibliographic citations. Within each category, bibliographic information is organized according to major alloy groups, e.g., aluminum alloys, beryllium alloys, cobalt alloys, etc., followed by bibliographies for miscellaneous alloys which are alloys either not properly identified or not having enough data to warrant a separate category. Each alloy group is further subdivided into individual commercial alloys, e.g., aluminum alloys AA 2024, AA 7075, AA 7090, etc., followed by miscellaneous aluminum alloys.				
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PREFACE

This MIAC Special Report contains bibliographic information on pertinent documents dealing with hot isostatic processing technology related to metals, alloys, and intermetallics published in the period 1966 to mid-1992.

MIAC is sponsored and administered by the Defense Technical Information Center (DTIC), ATTN: DTIC-AI, Cameron Station, Building 5, Alexandria, Virginia 22304-6145, under the Information Analysis Centers Program Management of Dr. Forrest R. Frank currently and Mr. Paul M. Klinefelter previously. MIAC is operated by the Center for Information and Numerical Data Analysis and Synthesis (CINDAS), Purdue University, 2595 Yeager Road, West Lafayette, Indiana 47906-1398, under the Defense Logistics Agency (DLA) Contract DLA900-90-D-0305.

MIAC is under the technical direction and monitoring of Mr. Jerome Persh, Staff Specialist for Materials and Structures, Office of the Director of Defense Research and Engineering (Science and Technology), ATTN: ODDR&E (S&T/AT), The Pentagon, Room 3D1089, Washington, DC 20301-3080.

MIAC serves as the DoD's central source of engineering and technical data and research and development information on monolithic metals, metal alloys, intermetallic compounds, and coatings utilized in Defense systems and hardware. Data and information on metal joints, welds, etc. are also covered. Emphasis is placed on those metals, alloys, intermetallic compounds, and coatings used in structural applications and/or in stringent environments.

Subject areas covered by MIAC include metals properties (especially mechanical properties as a function of temperature, and environmental conditions); latest research and development concepts, results, and trends; applications and processing of metals; processing equipment; measurement and testing of metals; test methods; quality control related to metals; corrosion/deterioration detection, prevention and control, and other environmental effects on metals and systems; producers, suppliers, and specifications for metals of concern to the DoD.

MIAC supports the Joint Logistics Commanders/Joint Directors of Laboratories Technology Initiative Panel for Advanced Materials, and provides assistance to or receives guidance from other defense programs and groups as designated by the technical monitor.

One of the authors, J. F. Radavich, is an Associate Professor in the School of Materials Engineering at Purdue University. In addition to MIAC staff who are listed on the cover of this report, MIAC staff Josephine C. F. Chen, Tanya Eurit, Pearnel Wilson, Kris Tomlinson, Greg Wood, and James Payne also contributed to the preparation of this report.

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INTRODUCTION

Hot isostatic pressing (HIP) uses a combination of elevated temperature and an inert gas pressure and is carried out in pressure vessels containing internal furnaces. HIP was invented by Saller et al. 37 years ago at Battelle Columbus Laboratories. An early Battelle report on Hot Isostatic Pressing, by Hanes et al. [1], was first issued in 1977. This report covered the history of HIPing, manufacturing systems, and studies of HIPing applications in the areas of castings, powder consolidation, and rejuvenation of used components. A more recent report in 1982 by Clauer et al. [2] reviewed more recent research dealing with the same subjects covered in the first report. Such studies confirmed the positive benefits of HIPing in a wide range of material compositions. The period of 1972-1982 in the field of HIPing may be considered as the decade of experimentation and confirmation of HIPing as a viable process to be used in the production of material components.

An important short coming of the report was the lack of information on the understanding of the metallurgical reactions which take place during the HIP process. The majority of research results focused on the closure of porosity as it affected mainly LCF and ductility. Many possible structural responses can occur when complex cast superalloys are heated in a temperature range of 1875°F to 2400°F for periods of two to four hours.

It is well known that superalloys have a wide solidification temperature range, i.e. the temperature difference between the liquidus and solidus. As the molten metal slowly solidifies, large grains and primary carbides nucleate and grow while at the same time the larger alloying elements diffuse slowly and segregate in the interdendritic regions. External and internal porosity results when the last liquid cannot fill the interstices.

The presence of surface connected porosity in the large castings prohibits internal porosity closure. Various methods of bridging over the surface porosity prior to HIPing have been tried, but a good coating method is still being sought. Perhaps, new coatings such as new boron nitride lubricant paints may provide a solution to this problem.

The HIP process can close internal casting porosity provided the proper temperature, pressure, and time conditions are selected. At the same time porosity closure is taking place, a certain degree of chemical homogenization is also taking place. However, there are undesirable reactions which can occur depending on the alloy composition. When the HIP temperature is too high, segregated areas are prone to incipient melting which cannot be rectified by thermal treatments. Another detrimental reaction is the breakdown of primary carbides and possible subsequent formation of continuous grain boundary carbide films and resultant embrittlement. In high boron content alloys, borides can also be solutioned and re-precipitated at grain boundaries. In Hf modified superalloys, the Hf can lose its beneficial effect by the formation of HfC.

It has been the authors' observation that when the as-cast gamma prime (γ') phase (the main strengthener in superalloys) is solutioned by high temperatures such as in a HIP process, the reprecipitated γ' phase due to post HIP heat treatments does not have the same composition as the as-cast γ' . The effects on mechanical properties due to the changes in such γ' are overshadowed by the positive improvements in mechanical properties with porosity closure. γ' effects on mechanical properties may be more evident in second generation HIP processing, i.e., first HIP of castings to close porosity and second HIP to rejuvenate properties.

One summation of HIP temperatures, pressures, and times for various superalloys is given by Bouse and Mihalisin [3]. They, too, caution the use of one blanket set of HIP parameters for different alloys without preliminary studies.

The uses of powders in components for high temperature service are mainly for disks and in dual alloy configurations. Powder materials are consolidated by either HIP, extrusion, and/or HIP plus forging/extrusion. Powder compacts exhibit fine grain structures and are more homogeneous in composition than cast/wrought products. The fine grain nature of consolidated powder components makes them suitable for low temperature applications like turbine disks.

Two disadvantages of the powder components are higher costs associated with powder production and the possibility of oxide inclusions being present which act as crack initiation sites for LCF failures. To overcome the problem with oxide inclusions, powder atomization processes are being developed which eliminate or replace the use of ceramic nozzles.

In the field of high temperature materials, HIP rejuvenation is now accepted as a viable method for reclaiming components which otherwise would be scrapped. Engine run components suffer from varying degrees of creep voids, internal cracking, and structural degradation. Used components which still meet all design specifications can be HIP rejuvenated by proper selection of HIP parameters and proper post HIP heat treatments to regenerate mechanical properties. Those blades which suffer from only long time structural degradation can be easily rejuvenated by thermal treatments. Successful use of HIP rejuvenation saves critical elements, reduces cycle replacement time, reduces costs, and saves on energy.

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1. Hanes, H. P., Seifert, D. A. and Watts, C. R., "Hot Isostatic Processing," Metals and Ceramics Information Center Report, MCIC-77-34, 103 pp., 1977.
2. Clauer, A. H., Meiners, K. E., and Boyes, C. B., "Hot Isostatic Processing," Metals and Ceramics Information Center Report, MCIC-82-46, 211 pp., 1982.
3. Bouse, G. K. and Mihalisin, J. R., "Metallurgy of Investment Cast Superalloy Components" in *Superalloys, Supercomposites and Superceramics*, (Tien, J. K. and Caulfield, T., Editors), Academic Press, Boston, Massachusetts, 1989.

ASSESSMENT AND FUTURE TRENDS OF HIP TECHNOLOGY

HIP technology is currently a very mature technology and is being used to consolidate powders of all types, close casting porosity, promote weld integrity, rejuvenate used turbine blades and vanes, etc. After the high cost of HIP equipment, the greatest consideration or deterrent for use of HIPing of materials is the high cost of the cycle time. As the number of parts per HIP run is increased, the cost per unit decreases, but with the need to HIP large castings, the cost per unit remains very high.

A summary of the research activities in the HIP technology for powder and cast components is presented in the following table.

**Summary of Research Activities
in HIP Technology for Powder and Cast Components**

Alloy	Number of Publications*						
	1966-1969	1970-1974	1975-1979	1980-1984	1985-1989	1990-1992	Total
Aluminum	0 (0)	6 (0)	4 (0)	21 (2)	8 (7)	3 (3)	54
Beryllium	3 (0)	23 (0)	26 (0)	8 (0)	3 (0)	0 (0)	63
Cobalt	0 (0)	11 (2)	4 (2)	7 (2)	3 (3)	2 (0)	36
Iron	0 (0)	11 (5)	26 (5)	37 (13)	15 (7)	10 (1)	130
Nickel	0 (0)	25 (4)	72 (37)	84 (61)	41 (53)	5 (7)	389
Refractories	0 (0)	3 (2)	1 (0)	4 (1)	5 (0)	3 (0)	19
Titanium	0 (0)	11 (1)	34 (27)	84 (35)	47 (21)	5 (0)	265
Intermetallics	0 (0)	0 (0)	1 (0)	5 (2)	17 (4)	42 (3)	74
	3 (0)	90 (14)	168 (71)	250 (116)	139 (95)	70 (14)	1,030

* Number in parentheses are for cast components.

The major thrust of the research in the early to mid-Seventies was to use beryllium to fabricate structural materials by HIPing. Attempts to develop cast and wrought beryllium products resulted in limited commercial success. Powder metallurgy techniques have been used to fabricate components for structural applications. Since beryllium is a relatively expensive material, most of the efforts were on the other cost cutting measures such as machining costs, scrap losses, and development of net shape components. However, interest in using HIPing technology for commercial fabrication of structural components slowly diminished which is evident from the number of documents published in the Eighties. Research activities in this decade were concentrated on nickel (and to a lesser extent, iron) superalloys and titanium alloys. The relative ease to produce near net shape components was the driving force behind acceptance of superalloys. Interests in the intermetallic alloys have increased significantly in the late Eighties and early Nineties.

Superalloys

Large Structural Castings

The development of new aircraft engines requires larger and more complex structural castings. It is estimated that the use of castings will increase by a factor of four before 1994 and the use of castings greater than 40 inches will increase even more substantially.

Currently, large structural components, such as engine cases, rings, frames, and supports, are made of various cast and wrought pieces joined together by welding and/or brazing. If extensive welding is required, distortion, increased costs, and long cycle times result.

An example of one such structural component is the CF6-80A turbine frame made of alloy 718 and weighing over 150 Kg (330 lb.) and 135 cm (53.15 in.) diameter with 61 separate pieces of varying wall thicknesses which must be joined by welding. By producing this component as a single casting, cycle time and distortion is greatly reduced and a \$20,000 cost reduction is realized.

Large structural castings are also being made of newer cast alloys such as René-220C, GTD-222, René-108 and IN-939. The trend is to go to Ni base superalloys for higher temperature applications and greater oxidation/sulphidation resistance. However, the structural responses to high temperature thermal treatments like welding repair, HIP, and longtime service needs to be characterized.

In order to successfully HIP fine grain components without grain growth, the HIP temperatures must be lower and the pressures higher. The HIP parameters selected must close porosity, minimize grain growth, and partially homogenize segregation. Generally, fine grain castings are given preHIP thermal treatments to help reduce segregation so as to minimize potential incipient melting.

At this same time, casting vendors have developed new casting techniques to produce fine grains and incorporating a HIP step to close porosity. Advances in wax and mold technologies coupled with the use of robotics for dipping large molds made possible production of large structural castings. Two fine grain casting processes, Grainex and Microcast-X have been developed by the Howmet Corporation, as well as a fine grain process by Precision Castparts.

Two main problems exist in the HIPing of large castings. The first problem is that larger HIP furnaces are required to accommodate the larger structural castings of the future. Currently, HIP furnace manufacturers are developing or have developed furnaces with hot zones up to 60 inches in diameter.

The second critical problem in HIPing is that the cycle time for a HIP run is too long. Because the long cool down in the HIP furnace produces undesirable structures, a post HIP solution heat treatment is necessary before final aging can take place to develop the mechanical properties. Two procedures are currently being explored to reduce cycle time. One method involves the cooling of the pressurizing gas by

external heat exchangers. A process to do this has been developed by ABB Autoclave Systems, Inc. which is called "HIP Quenching." The other method is to cool the pressurizing gas by introduction of cool gas. Both methods are promising but the critical factor is whether the material can be cooled uniformly.

Quick HIP

A recent development to reduce cycle time is a process called Quick HIP. In this process the material is first heated externally to the HIP furnace and then given a quick HIP at high pressures in a pressurized furnace. This technology would reduce the heating and cooling part of the conventional HIP cycle. This is still in the experimental stages for this technology.

Cast Turbine Blades

During the decade of 1982-1992, equiaxed and D. S. turbine blades were being routinely HIPed to close casting porosity. Since most of the blade components are large grain structures, grain growth during HIPing is not a problem. However, in the case of single crystal blades, closure of casting porosity at high temperatures may be accompanied by the formation of areas of small recrystallized grains which are unacceptable for high temperature operation. Opinions are divided over whether to HIP single crystals due to the possibility of producing recrystallized grains; however, more single crystal blades are being HIPed without encountering the recrystallization effect. Since the HIP temperature controls the tendency for the recrystallization process, HIPing of single crystal blades should be done at the lowest possible HIP temperature for porosity closure.

Turbine Disks

Currently some turbine disks are made of powder, but the majority of disks are small grain wrought products. Materials being considered for disk applications are conventional alloys but subsolvus (γ prime) processed to retain fine grain structures. However, when these materials are subsolvus processed, the yield of the final component is so low that the resultant high material cost makes powder disks of the same composition very competitive.

HIP rejuvenation studies of used wrought turbine disks have been unsuccessful since the high temperatures involved in the HIP process produces large grain growth. This would make such disks unacceptable for low temperature applications. However, used powder turbine disks might be amenable to HIP rejuvenation since fine grains in powder components resist grain growth to a much higher temperature than their wrought counterparts.

Titanium Alloys

The strength to density ratio of titanium alloys coupled with their fracture toughness and fatigue properties make them attractive for aeronautical and space applications. First Ti-6Al-4V and later Ti-6Al-2Sn-4Zr-2Mo were used in early gas turbine engines but as the operating temperature increased these were replaced with nickel superalloys. In advanced gas turbine engines, titanium alloys are used mainly as compressor discs and fan blades. Today titanium alloys are more important as structural materials for modern warplanes and spacecraft.

Research on HIPing of titanium alloys focused mainly on fabrication of powder components and near net shape forming. These processes make titanium alloys more economical by increasing low temperature strength and while limiting scrap material and machining cost. This was demonstrated by using P/M near net shaped Ti-6Al-6V-2Sn for fuselage braces on the navy F-14A. Also investigated was increasing the performance of titanium castings as well as repair and rejuvenation of used titanium castings. HIPing of

titanium castings can close cracks and remove the porosity thus increasing the strength and fatigue life. HIPing is essential for castings that are to be machined or welded.

Intermetallics

The main advantages of intermetallic alloys over conventional alloys for high temperature structural applications are high melting points, low density, good high temperature strength and oxidation resistance. While the major disadvantages have been room temperature ductility and fabrication, pursued mainly as aircraft turbine engine materials, the aluminides and silicides have shown the most promise. Particularly, monolithic as well as composites of TiAl, Ti₃Al, Ti₂AlNb, NiAl and MoSi₂ have been considered for both compressor blades, vanes, discs and shafts and turbine blades, discs and nozzles.

Other intermetallic alloys, most noticeably Fe₃Al and Ni₃Al, are already in use as or are being tested for applications such as dies for Fe-B-Nd automotive magnets, automotive turbocharger rotors, roller bearings, hydroturbines and feed water pumps with improved cavitation erosion resistance, heating elements for toasters and clothes dryers, hot gas filters for coal gasification systems and coatings for oxidation and sulfidation resistance.

Recommendations

It is an accepted fact that porosity closure of castings reduces the amount of materials scrapped, but care should be exercised to reject any trend to lower the initial high quality of materials on the premise that HIPing will make poor quality materials good.

In the future more emphasis should be placed on the re-use of engine run components by application of the HIP rejuvenation technologies. In addition, ongoing structural studies coupled with HIP cycles need to be carried out on newer and more complicated cast alloys which are being considered for long time operation at increasingly higher temperatures.

ORGANIZATION

The Bibliography on Hot Isostatic Pressing (HIP) Technology presented here is concerned with HIP of unalloyed metals, metal alloys, and intermetallic compounds. Most of the literature cited deals with structural materials and/or materials designed to perform at high temperatures. The emphasis is placed on HIP techniques, microstructural changes, and effects on creep, fatigue, corrosion, and mechanical properties.

This bibliography contains 950 individual citations published from 1966 to mid-1992 and covers over 450 different materials organized on three hierarchical levels. The first level is the material processing (powder metallurgy, casting, or miscellaneous); the second is material class (nickel alloys, aluminum alloys, intermetallic compounds, and so forth); and the third is the specific alloy (Udimet 700, NiAl, Ti-6Al-4V, and so forth). Within each level, a miscellaneous category contains either undefined materials or specific materials for which there were insufficient entries to warrant a separate category.

The miscellaneous category in the first level contains all materials that could not be properly identified either as powder metallurgy or cast materials. This section also includes citations on HIP equipment, computer simulations, or theoretical models. In the second level, the miscellaneous category includes citations on material classes that do not warrant separate sections and citations that specify the processing condition but not the material class. For example, the "Powder Metallurgy/Miscellaneous" section may include a citation with information on ball milled material without detailing material class as well as a citation for powder metallurgy Mg-5Li-5Si alloy. At the innermost or third level, the miscellaneous category contains those specific materials with only a few citations and materials referred to by material class only. A citation, for example, on cast aluminum alloys which does not specify alloy type would be found in the section for "Cast Materials/Aluminum Alloys/Miscellaneous Materials," along with a citation on cast AA 6061 which has only a few citations. A complete alphabetical list of materials covered in this report, with the pages on which they appear, is included at the end of the report under "MATERIALS LIST." An alphabetical list of the most common keywords is also included in the "INDEX TERMS."

This report is organized so that each section is complete and self-contained. This means that a given citation is listed more than once whenever the cited work covers more than one material. An entry for a journal article on the "Microstructure and Property Improvements in 7075 and 8090 Aluminum Alloys by Spray Forming" will be cited in the section for AA7075 and also will be repeated in the section for AA8090. An entry for a report on the "Mechanical Property Difference Between HIP Powder Metallurgy and HIP Cast Ti-6Al-4V" will be cited in the "Powder Metallurgy" section as well as in the "Castings" section for that material. By organizing the report in this fashion, cross referencing is eliminated: all pertinent entries are listed under every area of coverage, and only the area or areas of interest need to be searched to find the needed information. Citations in each section are listed in reverse chronological order. This should make searches quicker and more efficient.

For alloys that have different commercial designations but the same/similar composition, and are therefore considered the same material, a list of those encountered in the report appears below:

1. Udimet 700, Astroloy, APK1, Nimonic AP1, Rene' 77
2. MA753, IN-853

3. C-103, WC-103
4. Alloy 454, PWA 1480
5. Mar-M250, Maraging (250)
6. Rene 150, PA 101 (low C)
7. Inconel 718, IN-718, Pyromet 718
8. X-40, X-45 (low C)
9. Maraging 300, Vascomax 300
10. HP 9-4-20 steel, 9Ni-4Co
11. A-286, JBK-75
12. IN-100, Rene' 100

To facilitate document acquisition, the appropriate identification numbers are provided: the Defense Technical Information Center (DTIC) AD- number; Department of Defense (DoD) or NASA report number, for government sponsored reports; corporate report number, for items that do not have a government report number; the contract number, when a report number is not available. For reports produced outside of North America, an NTIS number, if available, is cited instead of a report or contract number.

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ALUMINUM ALLOYS

AA 2024

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Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness
2. **Aluminum Powder Metallurgy Technology for High Strength Applications**
Pickens, J. R.
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Key Words: AA 3003, AA 5083, AA 2024-T4, AA 7075-T6, AA 2024-T3510, AA 7075-T6510, MA67, MA87, IN9051, AA 7075-T73, AA 7475-T651, AA 7475-T7351, AA 7050-T3651, AA 7050-T651, AA 7050-T7351, AA 2124-T851, Al-4Ti, Al-8Fe, degassing, tensile properties, fatigue, fracture toughness, stress corrosion
3. **Structure and Property Control through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Contract No : DAHC15-70-C-0283, 411 pp., 1973 (AD-775 225)
Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties
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Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

AA 7075

1. **Microstructural and Property Improvements in 7075 and 8090 Aluminum Alloys by Spray Forming**
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Key Words: AA 7075, AA 8090, properties improvements, spray forming, tensile properties, fracture toughness

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Key Words: AA 7091, AA 7090, AA 7064, AA 7075, AA 7050, mechanical alloying, tensile properties, fatigue, fracture toughness

3. **Advanced Processing and Properties of High Performance Alloys**
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Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA
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Author Anon
National Materials Advisory Board (NAS-NAE), Washington DC
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Key Words: AA 7475, MA67, MA87, AA 2124, AA 7075, extrusion, rapid solidification, dendrite structure

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AA 7090

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AA 7091

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BERYLLIUM AND BERYLLIUM ALLOYS

Beryllium

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Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile properties, sintering
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Lawrence Livermore National Lab, Livermore, CA
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Key Words: beryllium, pitting, microstructure, voids
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Key Words: beryllium, density, grain size, tensile properties, strain rate dependence
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Key Words: beryllium, copper addition, microstructure, grain size, bend test
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Key Words: beryllium, grain size, fracture toughness, compressive properties

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 Heiple, C. R., Smugeresky, J. E., Capes, J. F.
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Key Words: titanium alloys, aluminum alloys, nickel alloys, beryllium, porosity, plasticity, impact strength, tensile properties, fatigue, sintering, cost, preheating

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Key Words: beryllium, re-entry vehicles, nose cones, porosity, density, tensile properties, fabrication, temperature effect, cold pressing

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Key Words: AISI 4340, beryllium, Ti-6Al-4V, pressure vessels

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 Turner, G. I., Lane, R. A., Lancaster, R. A.
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Key Words: beryllium, microcracking, cleavage, fracture mechanics temperature effect, activation energy

15. **Effects of Oxide and Grain Size in High-Purity Beryllium**
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Key Words: beryllium, grain size, grain refinement, microstructure morphology, particle size, tensile properties, hardness fracture surface, density

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Key Words: beryllium, tensile properties, grain size, creep properties
 fracture toughness, ball milling

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Key Words: beryllium, tensile properties, particle size

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 effect

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Key Words: beryllium, porosity, density, tensile properties, temperature
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Key Words: beryllium, tensile properties, density, temperature effect

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Key Words: beryllium, tensile properties, fabrication

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Key Words: beryllium, copper, mirror, coatings, temperature effect

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Channon, S. L.
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Key Words: beryllium, applications, tensile properties, compressive properties, plasma deposition, cost

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Kawecki Berylco Industries Inc., Reading, PA
Contract No : F33615-75-C-5041, 18 pp., 1976 (AD-A024 780)
Key Words: beryllium, beryllium alloys, machining, etching, tensile properties

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Key Words: beryllium, oxygen addition, silicon addition, tensile properties, microstructure, grain size, grain growth, grain boundaries, Charpy impact

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Key Words: beryllium, plasma deposition, tensile properties, fracture mechanics, ductility

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Rept No : AFML-TR-73-258, 31 pp., 1974 (AD-781 065)
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Key Words: beryllium, re-entry vehicles, oxide addition, aluminum addition, silicon addition, creep, grain size, plastic deformation, dislocation density, finite element analysis

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Key Words: beryllium, grain growth, recrystallization, density, tensile properties, texture

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 Odegard, B. C.
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Key Words: beryllium, microstructure, grain size, tensile properties,
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Key Words: MPDC, beryllium, nose cones, tensile properties, fracture surface,
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Key Words: beryllium, bend test, mechanical properties

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Key Words: beryllium, aluminum coating, microstructure, diffusion bonding,
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 Rept No : AFML-TR-72-263, 268 pp., 1972 (AD-908 569L)
Key Words: beryllium, MPDC, GB-2, re-entry vehicles, microstructure, tensile
 properties, outgassing, fabrication, cost, heat treatment

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Key Words: beryllium, manufacturing process

39. **Development of Porous Beryllium by the Hot Isostatic Pressing of Plasma-Spheroidized Powder**
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 Key Words: beryllium, tensile powder, rupture modulus

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Key Words: beryllium alloys, grain size, powder metallurgy, net shape forming, tensile properties
2. **Materials Research for Advanced Inertial Instrumentation Task 1. Dimensional Stability of Gyroscope Structural Materials**
Kumar, K., Cardarelli, D., Petri, F.
Charles Stark Draper Lab Inc., Cambridge, MA
Technical Research Report Number Five
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Key Words: HIP 50, X-520, microstructure, microscopy, microcreep
3. **Materials Research for Advanced Inertial Instrumentation Task 2. Gas Bearing Material Development**
Das, D., Kumar, K.
Charles Stark Draper Lab Inc., Cambridge, MA
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Key Words: beryllium alloys, microstructure, metallography, ion implantation, wear tests
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Kumar, K., Petri, F., Wollam, J.
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Rept No : R-1527, , 48 pp., 1981 (AD-A113 497)
Key Words: HIP 50, Be alloy X-520, microstructure, creep, tensile properties, dimensional stability, x-ray diffraction
5. **A Fundamental Study of Flow and Fracture in Beryllium**
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Key Words: HIP 50, beryllium alloys, tensile properties, compressive properties, grain size
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Key Words: S-65 beryllium, fractography, tensile properties, hardness
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Key Words: S-65, P1, beryllium alloys, beryllium oxide addition, stress intensity, tensile properties, notch properties
10. **Factors Influencing The Creep Strength of Hot Pressed Beryllium**
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Key Words: RR242, RR243, BSP9, BSP10, T30, 9776, 9715, 1707, 1353, 8084, creep, grain size, dislocation density, annealing
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Key Words: beryllium alloys, microstructure, grain size, ductility, tensile properties, hardness, stress relieving
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Rept No : AFML-TR-73-109, 126 pp., 1973 (AD-913 300L)
Key Words: RENE' 95, MPDC, turbine components, microstructure, grain size, tensile properties, machining, creep rupture

15. **Manufacture of Beryllium Structures**
Denny, John P., Burns, Robert H., Solbach, Robert C., Schoenly, D. K.
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Final Report Nov 72-Mar 73
Rept No : AFML-TR-73-251, 56 pp., 1973 (AD-917 815L)
Key Words: MPDC, beryllium, nose cones, tensile properties, fracture surface,
machining, fabrication

16. **Establishment of a Manufacturing Process for Thin Walled Conical Beryllium Structures Involving Hot Isostatic Pressing**
Mueller, J. J., Hanes, H. D.
Battelle Memorial Institute, Columbus, OH
Final Technical Report Dec 69-Jul 72
Rept No : AFML-TR-72-263, 268 pp., 1972 (AD-908 569L)
Key Words: beryllium, MPDC, GB-2, re-entry vehicles, microstructure, tensile
properties, outgassing, fabrication, cost, heat treatment

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Mueller, J. J., Hanes, H. D.
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Rept No : RTD-IR-271-9(I), 48 pp., 1970 (AD-D105 337L)
Key Words: SP-200, SP-350, P-21, P-50, GB-2, beryllium alloys, tensile
properties, fracture, outgassing, bubble formation

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Key Words: GB-2, beryllium alloys, particle size, density, tooling

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Key Words: SP-200, MPDC, tensile properties, plastic deformation,
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Key Words: Lockalloy, beryllium alloys, hydrostatic extrusion, texture,
tensile properties, shear forming

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Johnson, M. R., Hanes, H. D., Pinkerton, G. B.
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COBALT ALLOYS

MAR-M509

1. **Modern Powder Metallurgy Science and Technology**
Lawley, A.
J Met 38 (8), 15-25, 1986 (AD-D136 435)
Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness
2. **Hot Workability of Cobalt-Base Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
Powder Metall Int 8 (2), 82-6, 1976 (AD-D107 172)
Key Words: X-40, MAR-M509, superplasticity, hot working microstructure, cracking, tensile properties, temperature effect
3. **Study of Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
NTIS, N77-13210, Springfield, VA
Final Report
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties
4. **Application of Hot-Isostatic Pressing, Hydrostatic Extrusion, and Deformable-Die Tube Tapering Processes to Production of Titanium-6Al-4V Tapered Tubes**
Meyer, G. E., Harth, G. H., Houck, J. A., Byrer, T. G.
Battelle Memorial Institute, Columbus, OH
Technical Report
Rept No : USAAMRDL-TR-72-71, 86 pp., 1973 (AD-759 504)
Key Words: MAR-M509, IN-100, Ti-6Al-4V, turbine components, microstructure, thermomechanics, die forging, cold drawing, extrusion
5. **Structure and Property Control through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Final Technical Report
Contract No : DAHC15-70-C-0283
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Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300, tensile properties
6. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
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Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Four, Jan-Jul 1972
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Key Words: AA 7075, IN-100, MAR-M509, AISI 1045, Maraging 300,
microstructure, fractography, tensile properties

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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
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Semi-Annual Technical Report Number Five, Jul-Dec 1972
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Key Words: IN-100, MAR-M509, 18Ni steel, microstructure, hot working, creep
properties, strain rate, tensile properties

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Grant, N. J., Pelloux, R. M.
Massachusetts Institute of Technology, Department of Metallurgy and Materials
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Proc First Army Materials Technology Conf, 317-36, 1972 (AD-D109 742)
Key Words: AA 2024-T4, IN-100, MAR-M509, atomization, silicon addition
hafnium addition, tensile properties, fatigue, segregation

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Widmer, R.
Industrial Materials Technology Inc., Woburn, MA
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Raquette Lake, NY, Aug-Sept 71, 16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710,
Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

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Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Two Jan-Jun 1971
Contract No : DAHC15-70-C-0283
191 pp., 1971 (AD-728 053)
Key Words: IN-100, Vascomax 300, MAR-M509, extrusion, tensile properties,
creep rupture, quenching

Stellite 6

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440,
Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite
12, Stellite 21, atomization, particle size, density, creep,
metal injection molding

2. **HIP-Tool Materials**
Bayer, E.
Powder Metall Int 16 (3), 117-20, 1984 (AD-D130 130)
Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming
3. **Metallography of Hot Isostatically Pressed Materials (Part 2)**
Piske, D., Wittner, I.
Pract Metall 21 (3), 107-17, 1984 (AD-D130 404)
Key Words: Ti-6Al-4V, Stellite 6, WC coating, diffusion welding, diffusion bonding
4. **Application Fields of the HIP-Technology**
Selistorfer, H.
Powder Metall Int 16 (6), 268-71, 1984 (AD-D131 767)
Key Words: Waspaloy, Udimet 700, Stellite 6, turbine components, net shape forming, mechanical properties, hardness
5. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties
6. **New Approach Widens the Use of HIP P/M**
Precis Met 40 (10), 32-4, 1982 (AD-D128 141)
Key Words: AISI 4650, Stellite 6, AISI 316, Ti-6Al-4V, porosity, cost, tensile properties
7. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

X-40

1. **Superalloys from Powder: Production and Properties**
Author Anon
National Materials Advisory Board (NAS-NAE), Washington DC
Final Report
Rept No : NMAB-369, 102 pp., 1981 (AD-B058 349L)
Key Words: RENE' 95, X-40, Maraging 300, turbine components, fatigue, rapid solidification, mechanical properties, atomization
2. **Grain Size Control in PM Superalloys**
Dahlen, M.
NTIS, N79-18021, Springfield, VA
Final Report
Rept No : N79-18021, 31 pp., 1977 (AD-D115 659)
Key Words: Udimet 700, IN-738, X-40, grain size, tensile properties, creep properties, hardness, fatigue, recrystallization, annealing

3. **Hot Workability of Cobalt-Base Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
Powder Metall Int 8 (2), 82-6, 1976 (AD-D107 172)
Key Words: X-40, MAR-M509, superplasticity, hot working microstructure, cracking, tensile properties, temperature effect

4. **Study of Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
NTIS, N77-13210, Springfield, VA
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

5. **Modern Methods of Powder Metallurgical Processing of Superalloys**
Gessinger, G. H., Bomford, M. J.
Brown, Boveri & Co. Ltd., Baden, Switzerland
Proc Symp High Temperature Materials in Gas Turbines 35 pp., 1973 (AD-D102 997)
Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment

6. **Specialty Methods of Powder Atomization**
Grant, N. J.
Massachusetts Institute of Technology, Cambridge, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 13 pp., 1971 (AD-181 533)
Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

7. **Coarse Powder Techniques**
Widmer, R., Industrial Materials Technology Inc., Woburn, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center, Raquette Lake, NY, Aug-Sept 71, 16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

Miscellaneous Cobalt Alloys

1. **Fully dense HIP compaction of mechanically alloyed amorphous powders**
Hiroshi, K., Toda, K., Yuine, T., Elsevier, London, UK
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl. 223-8, 1992
Key Words: Co(79.5)Nb(15)Zr(5.5), compaction, density, viscous flow, porosity

2. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

3. **Properties of 'Stellite' (R) Alloy No. 21 Made Via Pliable Powder Technology**
Aizaz, A., Kumar, P.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 675-93, 1985 (AD-D138 355)
Key Words: Stellite 21, microstructure, Ceracon processing, fatigue, tensile properties

4. **A Comparison of the Fatigue Properties of Cast Wrought and HIP P/M Cobalt-Chromium Prosthetic Alloys**
Runkle, J. C., Nicholson, J., Rice, J.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 705-25, 1985 (AD-D138 356)
Key Words: PREP, F-75, tensile properties, fatigue stress

5. **HIP-Tool Materials**
Bayer, F.
Powder Metall Int 16 (3), 117-20, 1984 (AD-D130 130)
Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming

6. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

7. **Application of Rapidly Solidified Superalloys**
Patterson, R. J.
United Technologies Corp., West Palm Beach, FL
Quarterly Report
Rept No : FR-8062, 22 pp., 1976 (AD-D108 171)
Key Words: MAR-M200, IN-100 Co-20Cr, airfoils, tantalum addition, microstructure, particle size, atomization

8. **Effect of Autoclave Heat Treatments on the Mechanical Properties of the Prealloyed Powder Cobalt-Base Alloy HS-31**
Freche, J. C., Ashbrook, R. L.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Note
Rept No : NASA-TN-D-7117, 22 pp., 1973 (AD-181 092)
Key Words: HS-31, microstructure, heat treatment, creep rupture, tensile properties

IRON ALLOYS

A-286

1. **Characterization of a Rapidly Solidified Iron-Based Superalloy**
Smugeresky, J. E.
Metall Trans 13A (9), 1535-46, 1982 (AD-D125 578)
Key Words: A-286, JBK-75, Fe-30Ni, microstructure, tensile properties, morphology
2. **Physical Metallurgy and Effects of Process Variables on the Microstructure of Wrought Superalloys**
Muzyka, D. R.
ASTM, Philadelphia, PA
Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure
3. **Microstructure and Properties of Hot Isostatically Pressed A-286**
Smugeresky, J. E., German, R. M.
Metall Trans 9A (2), 253-9, 1978 (AD-D111 960)
Key Words: A-286, microstructure, tensile properties, brittle fracture intergranular fracture, carbide precipitation, titanium carbides
4. **Fracture Path in Hot Isostatically Pressed Superalloy A286**
German, R. M., Smugeresky, J. E., Karfs, C. W.
Powder Metall Int 9 (4), 178-9, 1977 (AD-D111 621)
Key Words: A-286, intergranular fracture, fracture surface, titanium carbides, grain boundaries
5. **The Consolidation and Properties of Hot Isostatically Pressed A286 Stainless Steel**
German, R. M., Smugeresky, J. E.
J Met 28 (12), p. A51, 1976 (AD-D110 121)
Key Words: A-286, tensile properties, fracture surface, aging

AISI 316

1. **HIP of Bi-modal Powder Mixtures: Modeling and Experiment**
Funkenbusch, P. D., Li, E. K. H.
Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 17-22, 1992
Key Words: AISI 316L, powder metallurgy, particle size optimization
2. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding

3. **Deposition and Determination of Argon in HIP-Parts**
 Stover, D., Buchkremer, H.P., Diehl, W., Kaiser, H., Laakmann, J.
 MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
 Proc Int Conf PM Aerospace Materials-87 8.1-8.9, 1988 (AD-D143 660)
Key Words: Udimet 700, AISI 316L, Hastelloy X, SEM, microscopy, porosity

4. **Advanced Processing and Properties of High-Performance Alloys**
 Koss, D. A.
 Department of Metallurgical Engineering, Michigan Tech University, Houghton
 Technical Report Number Four
 Contract No : N00014-85-K-0427
 19 pp., 1986 (AD-A167 404)
Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

5. **Progress of Powder Metallurgy in North America**
 Roll, K.H., Johnson, P.K.
 Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

6. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
 Nyce, A. C.
 Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

7. **Superalloys More Super Than Ever**
 McIntyre, R. D.
 Mater Eng 95 (1), 36-43, 1982 (AD-D124 025)
Key Words: RENE' 95, IN-100, AISI 316, microstructure, recrystallization, creep rupture, oxidation, tensile properties

8. **New Approach Widens the Use of HIP P/M**
 Precis Met 40 (10), 32-4, 1982 (AD-D128 141)
Key Words: AISI 4650, Stellite 6, AISI 316, Ti-6Al-4V, porosity, cost, tensile properties

9. **Trends in Powder Metallurgy Technology**
 Chandler, H. E., Baxter, D. F.
 Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming

10. **Corrosion Behavior of P/M and Conventionally made 316-L Stainless Steel**
 Nazmy, M. Y., Karner, W., Al-Gwaiz, A. A.
 J Met 30 (6), 14-9, 1978 (AD-D112 730)
Key Words: AISI 316L, corrosion, pitting, microstructure

11. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
 Jaffee, R. I.
 Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

12. Specialty Methods of Powder Atomization

Grant, N. J.

Massachusetts Institute of Technology, Cambridge, MA

Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center,

Raquette Lake, NY, Aug-Sept 71

13 pp., 1971 (AD-181 533)

Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316, REP, microstructure, ultrasonic testing, fatigue, tensile properties

AISI 4340

1. P/M Processing of the Rare Earth Modified High Strength Steels

Sheinker, A. A.

TRW Inc., Materials Technology, Cleveland, OH

Rept No : TRW-ER-8097-2, 68 pp., 1980 (AD-A094 185)

Key Words: AISI 4340, rare earth addition, tensile properties, Charpy impact

2. Application of Superplastic Steels

Slaughter, E. R., Bourdeau, R. G.

Pratt and Whitney Aircraft Group, West Palm Beach, FL

Rept No : FR-10233, 20 pp., 1978 (AD-D108 306)

Key Words: AISI 4340, airfoils, aluminum addition, titanium addition, boron addition, tensile properties, superplasticity, thermomechanical treatment

3. Hot Isostatic Pressing: An Economic Route to Powder Components

James, P. J.

Metals and Materials 27-31, 1977 (AD-D111 600)

Key Words: AISI 4340, beryllium, Ti-6Al-4V, pressure vessels

4. A Method for Specifying Hot Isostatic Pressure Welding Parameters

Bryant, W. A.

Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)

Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joining, temperature effect, modulus of elasticity, melting point

M-2

1. Mechanical Properties of PH-IHIPed M2 high speed steel(HSS)

Kothari, N. C.

Diffus Defect Data, Pt B 25-26, 471-8, 1992

Key Words: M-2, vanadium addition, austenitizing, tempering, mechanical properties, impact strength, bend strength, hardness

2. Progress of Powder Metallurgy in North America

Roll, K.H., Johnson, P.K.

Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)

Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

3. **Containerless HIPing of PM Parts: Technology Economics and Equipment Productivity**
Nyce, A. C.
Met Powder Rept 38 (7), 387-92, 1983 (AD-D128 150)
Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties
4. **Hot Isostatic Processing**
Clauer, A. H., Meiners, K. E., Boyer, C. B.
Metals Information Analysis Center, West Lafayette, IN
Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)
Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792 Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment
5. **Properties of High-Speed Steels Produced by Powder Metallurgy**
Takigawa, H., Manto, H., Kawai, N., Homma, K.
Powder Metall 24 (4), 196-202, 1981 (AD-D122 928)
Key Words: M-2, M-3, M-35, M-36, AISI 1050, AISI 1040, AISI 321, AMS 6512, cutting tools, density, bend strength, toughness, cost
6. **Trends in Powder Metallurgy Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 100-3, 1980 (AD-D117 225)
Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet engines, net shape forming
7. **The P/M Extrusion of Tool Steel Bar**
Dunkley, J. J., Causton, R. J.
Int J Powder Metall Powder Technol 13 (1), 13-20, 1977 (AD-D108 864)
Key Words: HSS, M-2, alloying, microstructure, hardness, impact properties, grinding, drilling, milling, cost, annealing, extrusion
8. **Toughness and Toughness Behavior of Two High-Speed Steels**
Berry, G., Kadhim Al-Tornachi, M. J.
Met Technol 4 (6), 289-95, 1977 (AD-D110 293)
Key Words: M-2, M-3, fracture toughness, fatigue, crack growth fracture mechanics, hardness, milling, tool life
9. **Crucible CPM Rex-High Speed Steel for Superior Cutting Tools**
Colt Industries Inc., N.Y., 5 pp., 1974 (AD-D104 321)
Key Words: M-1, M-2, M-7, M-10, M-42, M-3, T-15, H41, cutting tools, tool life, Charpy impact, impact toughness, wear, grain size

MA 956

1. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
Contract No : NAS 3-20072
44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

2. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Sheffler, K. D., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, East Hartford, CT
 Quarterly Technical Progress Report Number Twenty Two, Jun.-Aug. 1981
 Contract No : NAS 3-20072
 36 pp., 1981 (AD-D122 325)
Key Words: Hastelloy X, MA956, Udimet 700, MERL 76, turbine components,
 combustor liners, airfoils, coatings, fatigue, erosion resistance

3. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A., Blecherman, S. S.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Sixteen, Dec 79-Feb-80
 Contract No : NAS3-20072
 44 pp., 1980 (AD-D118 687)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners,
 tensile properties, creep rupture, coatings, plasma
 deposition, dispersion hardening

4. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Seventeen, 1 Mar-31 May 1980
 Contract No : NAS 3-20072
 64 pp., 1980 (AD-D118 782)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners,
 compressor components, airfoils, fatigue, creep properties,
 coatings, mechanical properties

5. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Eighteen, 1 Jun-31 Aug 1980
 Contract No : NAS 3-20072
 47 pp., 1980 (AD-D119 486)
Key Words: MERL 76, MA956, Hastelloy X, turbine components, tensile
 properties, fatigue, coatings

6. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number nineteen, 1 Sept-30 Nov 1980
 Contract No : NAS 3-20072
 35 pp., 1980 (AD-D120 344)
Key Words: MERL 76, Haynes 8077, MA956, aircraft engines, turbine components,
 combustor liners, compressor components, airfoils, fatigue,
 net shape forming, coatings

7. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Gell, M.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Progress Report Number Thirteen
 Contract No : NAS3-20072
 47 pp., 1979 (AD-D116 198)
Key Words: Haynes 8077, MA956, MERL 76, turbine components, combustor liners,
 tensile properties, creep properties, dispersion hardening

8. Powder Metallurgy Techniques Applied to Superalloys

Benjamin, J. S., Larson, J. M.

J Aircr 14 (7), 613-23, 1977 (AD-D109 882)

Key Words: Udimet 700, RENE' 95, MA956E, MA754 turbine components, creep rupture, hot corrosion, oxidation, grain size, thermomechanical treatment

MAR-M250

1. Microstructures and Mechanical Properties of HIP Consolidated 18% Ni Maraging Steel

Komatsubara, N., Hayzelden, C., Cantor, B.

Powder Metall 30 (2), 119-24, 1987 (AD-D137 558)

Key Words: MAR-M250, microstructure, fracture, atomization, tensile properties

2. Hot Isostatic Processing

Clauer, A. H., Meiners, K. E., Boyer, C. B.

Metals Information Analysis Center, West Lafayette, IN

Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)

Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

3. Ductility in Hot Isostatically Pressed 250-Grade Maraging Steel

German, R. M., Smugeresky, J. E.

Metall Trans A 9A (3), 405-12, 1978 (AD-D112 162)

Key Words: MAR-M250, tensile properties, microstructure fracture surface, fabrication

4. Effect of Hot Isostatic Pressing Temperature on the Properties of Inert Gas Atomized Maraging Steel

German, R. M., Smugeresky, J. E.

Mater Sci Eng 36 (2), 223-30, 1978 (AD-D114 558)

Key Words: Maraging(250), microstructure, particle size, tensile properties, temperature effect

5. A Method for Specifying Hot Isostatic Pressure Welding Parameters

Bryant, W. A.

Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)

Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joining, temperature effect, modulus of elasticity, melting point

Maraging 300

1. Superalloys from Powder: Production and Properties

Author Anon

National Materials Advisory Board (NAS-NAE), Washington DC

Rept No : NMAB-369, 102 pp., 1981 (AD-B058 349L)

Key Words: RENE' 95, X-40, Maraging 300, turbine components, fatigue, rapid solidification, mechanical properties, atomization

2. **Soviet Activities in Iron and Titanium Powder Metallurgy**
Marley, W. F., Jr.
Metal Powder Industries Federation, Princeton, NJ
P/M Ordnance Seminar, Powder Metallurgy in Defense Technology
5 pp., 1978 (AD-D116 028)
Key Words: Maraging 300, titanium alloys, shock loading, dispersion
hardening, thermomechanical treatment

3. **Properties of Maraging Steel 300 Produced by Powder Metallurgy**
Van Swam, L. F., Pelloux, R. M., Grant, N. J.
Powder Metall 17 (33), 33-45, 1974 (AD-D100 184)
Key Words: Maraging 300, tensile properties, fatigue, aging, annealing

4. **Structure and Property Control through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Final Technical Report
Contract No : DAHC15-70-C-0283
411 pp., 1973 (AD-775 225)
Key Words: AA 7075, AA 2024, AISI 1045, IN-100, MAR-M509, Maraging 300,
tensile properties

5. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile
properties, fatigue, hardness, creep rupture, fracture toughness

6. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Four, Jan-Jul 1972
Contract No : DAHC15-70-C-0283
140 pp., 1972 (AD-749 679)
Key Words: AA 7075, IN-100, MAR-M509, AISI 1045, Maraging 300,
microstructure, fractography, tensile properties

7. **Specialty Methods of Powder Atomization**
Grant, N. J.
Massachusetts Institute of Technology, Cambridge, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center,
Raquette Lake, NY, Aug-Sept 71
13 pp., 1971 (AD-181 533)
Key Words: IN-100, Maraging 300, 18/8 stainless, AA 2024, X-45, AISI 316,
REP, microstructure, ultrasonic testing, fatigue, tensile properties

8. **Coarse Powder Techniques**
Widmer, R.
Industrial Materials Technology Inc., Woburn, MA
Proc 18th Sagamore Army Materials Research Conf, Sagamore Conference Center,
Raquette Lake, NY, Aug-Sept 71
16 pp., 1971 (AD-181 534)
Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710,
Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

9. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Two Jan-Jun 1971
Contract No : DAHC15-70-C-0283
191 pp., 1971 (AD-728 053)
Key Words: IN-100, Vascomax 300, MAR-M509, extrusion, tensile properties,
creep rupture, quenching

T-15

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
Powder Metall Int 23 (4), 246-52, 1991
Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440,
Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite
12, Stellite 21, atomization, particle size, density, creep,
metal injection molding

2. **Powder Metallurgy T15 Tool Steel: Part I. Characterization of Powder and Hot Isostatically Pressed Material**
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Santos, M., Gomes, M., Oliveira, M. M., Rebbeck, M. M., Wronski, A. S.
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Key Words: T-15, HSS, water atomization, sintering, transverse rupture
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Key Words: T-6, T-15, microscopy, high speed steel, sintering, fracture toughness, hardness

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Key Words: T-15, Rex 25, tool steel, microstructure, hardness, size distribution

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 Brown, Paul F., Bogardus, Glen A., Miner, J. R.
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 Lasday, S. B.
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1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
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Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding
2. **Influence of Powder Surface Oxidation on Some Properties of HIPed Martensitic Chromium Steel**
Arnberg, L., Karlsson, A.
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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

14. **Medium and High Alloy P.M. Steel Products by Hot Isostatic Pressing**
Garvare, T., Benning, C.
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Key Words: 3Cr steel, 3.5Ni steel, 12Cr steel, impact properties creep rupture, tensile properties, hardness, net shape forming

15. **Basic Trends in Advanced Fabrication Processes**
Walther, H. H.
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12, Stellite 21, atomization, particle size, density, creep,
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Key Words: Haynes 21, Stellite 6, tool steel, stainless steel, microstructure, impact toughness, tensile properties, net shape forming

16. **A Fundamental Study of Tool Steels Processed from Rapidly Solidified Powders**
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27. **Evaluation of Powder Processed Turbine Engine Ball Bearings**
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 modulus of elasticity, melting point

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NICKEL ALLOYS

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Key Words: AF-115, Waspaloy, Inconel 718, turbine components, tensile properties, fatigue, cracking
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Key Words: MERL 76, IN-100, AF-115, creep rupture, tensile properties, fatigue
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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging
5. **Long Life Disks from Rapidly Solidified Materials. Volume 1 RENE' 95 and AF115 Process Development**
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Rept No : AFWAL-TR-82-4032-Vol-1, 301 pp., 1982 (AD-B080 374L)
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10. **The Stress Behavior of Three Advanced Nickel-Base Superalloys during
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Key Words: AF-115, AF 2-1DA, microstructure, crack nucleation, defects, tensile properties, fatigue stress

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 Conway, J. B., Stentz, R. H.
 Mar-Test Inc., Cincinnati, OH
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Key Words: AF 2-1DA, MAR-M432, TRW NASA VI A, Udimet 700, turbine components, particle size, density, fatigue, crack growth, creep rupture, tensile properties, thermomechanical treatment

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1. **Flow Behavior of Nickel-Base Superalloys at Isothermal Forging Temperatures and Strain Rates**
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Key Words: IN-100, MAR-M200, Alloy 713LC, grain size, deformation, flow properties

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Key Words: IN-738LC, IN-939, IN-597, IN-100, Alloy 713LC, Nimonic 105, Udimet 520, Udimet 700, turbine components, welding, cyclic fatigue, coatings, corrosion, creep

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Key Words: IN-100, Maraging 300, X-45, MAR-M509, Hastelloy X, Udimet 710, Alloy 713, Ti-6Al-6V-2Sn, microstructure, creep rupture, tensile properties

Hastelloy X

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Key Words: Udimet 700, AISI 316L, Hastelloy X, SEM, microscopy, porosity

2. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
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Contract No : NAS 3-20072, 44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

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Key Words: RENE' 95, Hastelloy X, AISI 304, contour rolling

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 Quarterly Technical Progress Report Number Sixteen, Dec 79-Feb-80
 Contract No : NAS3-20072
 44 pp., 1980 (AD-D118 687)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, tensile properties, creep rupture, coatings, plasma deposition, dispersion hardening

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Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, compressor components, airfoils, fatigue, creep properties, coatings, mechanical properties

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Key Words: MERL 76, Haynes 8077, MA956, aircraft engines, turbine components,
 combustor liners, compressor components, airfoils, fatigue,
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IN-100

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Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440,
 Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite
 12, Stellite 21, atomization, particle size, density, creep,
 metal injection molding

2. **Mechanical Properties of Powder Ni-Base Superalloy Consolidated by HIP**
 Takigawa, H., Iwai, K., Kawai, N., Kokomaku, T.
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Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid
 sintering, creep rupture

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Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP,
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Torisaka, Y., Nakazawa, Y., Miyagawa, M.
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Key Words: IN-100, forging, gatorizing, extrusion, tensile properties, hardness

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Key Words: IN-100, tensile properties, superplasticity

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Immarigeon, J-P., Koul, A. K.
Pergamon Press, Elmsford, NY
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Key Words: IN-100, MAR-M200, Alloy 713LC, grain size, deformation, flow properties

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Key Words: AA 2219-T851, Udimet 700, MERL 76, IN-100, RENE' 95, creep, cracking, tensile properties, creep rupture

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Bain, K. R., Pelloux, R. M.
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Key Words: RENE' 95, Inconel 718, IN-100, Inconel X-750, Udimet 700, creep, crack growth, fractography

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Key Words: Udimet 700, MERL 76, IN-100, RENE' 95, grain boundaries, notch properties, aging, embrittlement

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Key Words: Udimet 700, IN-100, RENE' 95, MERL 76, weld and post weld, tensile properties, fatigue

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Final Report Aug 77-Jun 82
Rept No : AFWAL-TR-83-4022, 312 pp., 1983 (AD-B079 132L)
Key Words: IN-100, net shape forming, tensile properties, fabrication

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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

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Key Words: RENE' 95, IN-100, AISI 316, microstructure, recrystallization, creep rupture, oxidation, tensile properties

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Key Words: RENE' 95, IN-100, Ti-6Al-4V, Ti-6Al-6V-2Sn, coatings, phase transformation, net shape forming

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Evans, D. J.
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Key Words: IN-100, Udimet 700, RENE' 95, MERL 76, Ti-6Al-4V, creep rupture, fatigue, fracture toughness

19. **Powder and Particulate Production of Metallic Alloys**
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Key Words: IN-100, Udimet 700, microstructure, creep rupture, porosity, intergranular fracture, splat quenching

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Pelloux, R. M.
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Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

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Key Words: RENE' 95, titanium alloys, tool steel, Udimet 700, IN-100, MERL 76, Waspaloy, turbine components, microstructure, tensile properties, stress intensity

22. **Cost 50: Materials for Gas Turbines**
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Key Words: IN-738LC, IN-939, IN-597, IN-100, Alloy 713I C, Nimonic 105, Udimet 520, Udimet 700, turbine components, welding, cyclic fatigue, coatings, corrosion, creep

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Key Words: IN-100, Udimet 700, MAR-M200, creep rupture, tensile properties

24. **Creep Rupture in Powder Metallurgical Nickel-Base Superalloys at Intermediate Temperatures**
Law, C. C., Blackburn, M. J.
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Key Words: AF-115, MAR-M432, IN-100, MERL 76, creep properties, tensile properties, lattice parameters, grain boundaries, heat treatment

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28. **Exploratory Development of Die Materials for Isothermal Forging of Titanium Alloys**
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Key Words: TRW NASA VI A, IN-100, IN-792, TAZ-8A, creep rupture, tensile properties, thermal fatigue

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Key Words: IN-100, RENE' 95, AF-115, turbine components, die forging, net shape forming, cost

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Key Words: IN-792, IN-100, turbine components, creep, Larsen-Miller curves, fatigue, tensile properties, Charpy impact, thermal cycling, thermal shock

33. **Application of Rapidly Solidified Superalloys**
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Key Words: MAR-M200, IN-100, 7Ni steel, 9Ni steel, turbine components, airfoils, rapid solidification, atomization, recrystallization, thermal stability

34. **Production of Components by Hot Isostatic Pressing of Nickel-Base Superalloy Powders**
 Blackburn, M. J., Sprague, R. A.
 Met Technol 4 (8), 388-95, 1977 (AD-D110 796)
Key Words: Incoloy 901, Waspaloy, Udimet 700, IN-100, turbine components, tensile properties, creep rupture, metallography

35. **Review of Advanced Powder Metallurgical Fabrication Techniques in European NATO Countries**
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Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V, Waspaloy, precipitation hardening

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Key Words: IN-100, Udimet 500, MAR-M246, Udimet 700, TD-nickel, chromium addition, porosity, cracking, creep rupture, grain growth, dispersion hardening, tensile properties, microstructure, hot corrosion, oxidation, thermomechanical treatment

44. **Application of Hot-Isostatic Pressing, Hydrostatic Extrusion, and Deformable-Die Tube Tapering Processes to Production of Titanium-6Al-4V Tapered Tubes**
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Grant, N. J., Pelloux, R. M., Flemings, M. C., Argon, A. S.
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Key Words: AA 2024-T4, IN-100, MAR-M509, atomization, silicon addition
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Surface and Coatings Technology 32 (1), 127-40, 1987 (AD-D137 763)
Key Words: IN-738, FeCrAlY coatings, microstructure, epitaxial growth,
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Kaieda, Y.
Trans Natl Res Inst Metals 28(3), 224-30, 1986 (AD-D138 855)
Key Words: IN-738, MA6000, MA753, turbine components, creep rupture
3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA
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Key Words: IN-738, MA6000, turbine components, tensile properties, dispersion
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Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1,
M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment
6. **Development of Hybrid Gas Turbine Bucket Technology**
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properties, unidirectional solidification, dissimilar joining,
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8. **Cost 50: Materials for Gas Turbines**
 Bunk, W., Hansen, J.
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Key Words: IN-738LC, IN-939, IN-597, IN-100, Alloy 713LC, Nimonic 105, Udimet
 520, Udimet 700, turbine components, welding, cyclic fatigue,
 coatings, corrosion, creep

9. **Forging and Powder Metallurgy Processing**
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Key Words: Nimonic 90, Udimet 520, Udimet 700, Inconel 718, IN-738, IN-100,
 turbine components, microstructure, creep properties, tensile
 properties, fatigue, precipitation, thermomechanical
 treatment

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 Hanes, H. D., Seifert, D. A., Watts, C. R.
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 Rept No : MCIC-77-34, 101 pp., 1977 (AD-A049 227)
Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700,
 IN-792, welding, tensile properties, pressure bonding

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 addition, mechanical alloying, grain size, grain structure,
 creep rupture, recrystallization

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 Dahlen, M.
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Key Words: Udimet 700, IN-738, X-40, grain size, tensile properties, creep
 properties, hardness, fatigue, recrystallization, annealing

13. **Review of Advanced Powder Metallurgical Fabrication Techniques in European NATO
 Countries**
 Sutcliffe, P. W.
 Advisory Group for Aerospace Research and Development, Paris, France
 Rept No : AGARD-R-641, 14 pp., 1976 (AD-A028 348)
Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V,
 Waspaloy, precipitation hardening

14. **Atomised Powder-The Key to New Alloys**
Wallis, P. B.
Powder Metall Int 8 (4), 167-9, 1976 (AD-D108 681)
Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

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Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

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Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

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Key Words: Ti-6Al-4V, IN-738, RENE' 77, IN-792, defects, diffusion bonding, elongation

IN-792

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Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Key Words: Udimet 700, AF-115, IN-792, MAR-M432, MERL 76, PA 101, RENE' 41, tensile properties, creep rupture, fatigue

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 Key Words: AA 7010-T73651, Corona-5, AA A357-T6, IN-792, fatigue, bearing
 strength, tensile properties, thermal expansion

5. **Exploratory Development of Die Materials for Isothermal Forging of Titanium Alloys**
 Kortovich, C. S., Marder, J. M.
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 Key Words: IN-792, IN-100, turbine components, creep, Larsen-Miller curves,
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 Key Words: IN-792, turbine components, hafnium addition, microstructure,
 tensile properties, creep rupture, temperature effect, cost

9. **Powder Metallurgy Production Processes**
 Clark, L. P.
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 Key Words: IN-100, AA 7075-T6, IN-792, Ti-6Al-4V, turbine components,
 nondestructive testing

10. **Hot-Isostatic Processing Reaches Maturity**
 Hanes, H. D.
 SAMPE Qtrly 5 (2), 1-9, 1974 (AD-D133 138)
 Key Words: Ti-6Al-4V, IN-738, RENE' 77, IN-792, defects, diffusion bonding,
 elongation

Incoloy 901

1. **Properties and Microstructures for Dual Alloy Combinations of Three Superalloys with Alloy 901**
Harf, F. H.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-86987, 42 pp., 1985 (AD-D134 337)
Key Words: Incoloy 901, RENE' 95, MERL 76, Udimet 700, turbine components, microstructure, tensile properties, creep rupture, joining
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Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
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44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue
3. **Mechanisms of Recovering Low Cycle Fatigue Damage in Incoloy 901**
Schafrik, R. E.
Air Force Inst of Tech, Wright-Patterson AFB, OH
Doctoral Thesis
Rept No : AFIT-CI-79-212D, 261 pp., 1979 (AD-A107 255)
Key Words: Incoloy 901, crack propagation, rejuvenation, aging, metallography, fatigue, tensile properties
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Muzyka, D. R.
ASTM, Philadelphia, PA
Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure
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Blackburn, M. J., Sprague, R. A.
Met Technol 4 (8), 388-95, 1977 (AD-D110 796)
Key Words: Incoloy 901, Waspaloy, Udimet 700, IN-100, turbine components, tensile properties, creep rupture, metallography
6. **Atomised Powder-The Key to New Alloys**
Wallis, P. B.
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Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

Inconel 625

1. **Relationship of Microstructure to Properties of HIP and Weld Clad Alloy 625 in Sour Environments**
Sisak, W. J., Ayer, R., Mueller, R. R., Leta, D. P., MS, Warrendale, PA
Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 803-20, 1991
Key Words: Inconel 625, AISI 4130, 2.25Cr-1Mo steel, cladding, welding, corrosive medium, mechanical properties, microstructure, carbides
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Birkholz, W.J., Stulga, J.E., Eisen, W.B., Moll, J.H.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Udimet 700, Inconel 625, RENE' 95, H-13 tool steel, precipitation hardening, tensile properties, thermal expansion, hardness, creep
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Stulga, J. E., McTiernan, B. J.
ASM International, Metals Park, OH
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Key Words: Inconel 625, atomization, rapid solidification, aging, tensile properties, hardness
4. **Metallurgical Evaluation of Cr Modified Cu-Ni and Inconel 625 Piping Made by Powder Metallurgy Methods**
Palko, W. A.
David W. Taylor Naval Ship Research and Development Center, Ship Materials Engineering Department, Annapolis, MD
Rept No : DTNSRDC/SME-84-65, 47 pp., 1984 (AD-B088 715L)
Key Words: Inconel 625, welding, hardness, grain size, corrosion, tensile properties
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Vaccari, J. A.
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Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

Inconel 718

1. **Structure/Property Evaluation and Comparison between Shock-Wave Consolidated and Hot-Isostatically Pressed Compacts of RSP Pyromet 718 Alloy Powders**
Thadhani, N. N., Mutz, A. H., Vreeland, T., Jr.
Acta Metall 37 (3), 897-908, 1989 (AD-D140 991)
Key Words: Pyromet 718, shock wave processing, impact tests, tensile properties, consolidation, rapid solidification

2. **Mechanical Properties of Ni-base Superalloy Disks Produced by Powder Metallurgy**
Iwai, K., Furuta, S., Yokomaku, T.
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Key Words: AF-115, Waspaloy, Inconel 718, turbine components, tensile properties, fatigue, cracking

3. **Production, Compaction and Application of Metal Powders**
Kawai, N., Honma, K., Takigawa, H., Iwai, K., Hirano, M.
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Key Words: 300M, Waspaloy, Inconel 718, AA 2218, AA 2219, AA 2618, AISI 52100, atomization, rapid solidification, tensile properties, net shape forming

4. **A Comparison Between Different Compounds for Improving the Corrosion Protection of FeCrAlY Coatings on Superalloys**
Burman, C., Ericsson, T., Kvernes, I., Lindblom, Y.
Surface and Coatings Technology 36 (1-2), 1-12, 1988 (AD-D140 581)
Key Words: Inconel 718, corrosion protection, TiN coatings, vacuum plasma spraying, oxidation

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Fiedler, H. C., Sawyer, T. F., Kopp, R. W., Leatham, A. G.
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Key Words: RENE' 95, Inconel 718, near net forming, tensile properties, fatigue, creep rupture

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Mutz, A.H., Thadhani, N.N., Vreeland, T., Jr.
DGM Informationsgesellschaft mbH, Germany
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Key Words: Pyromet 718, Inconel 718, microscopy, tensile properties, shock loading, aging

7. **Mechanical Properties and Microstructure of Centrifugally Cast Alloy 718**
Michel, D. J., Smith, H. H.
Naval Research Lab, Washington DC
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Key Words: Inconel 718, microstructure, tensile properties, hardness, creep rupture, fractography

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Bain, K. R., Pelloux, R. M.
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Key Words: RENE' 95, Inconel 718, IN-100, Inconel X-750, Udimet 700, creep, crack growth, fractography

9. **Hot Isostatic Processing**
Clauer, A. H., Meiners, K. E., Boyer, C. B.
Metals Information Analysis Center, West Lafayette, IN
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Rept No : MCIC-82-46, 228 pp., 1982 (AD-A132 232)
Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1, M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

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Brown, C. W., Hicks, M. A.
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Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

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Muzyka, D. R.
ASTM, Philadelphia, PA
Proc Symp MiCon 78, 526-46, 1979 (AD-D126 409)
Key Words: A-286, Incoloy 901, Inconel 718, Waspaloy, RENE' 95, Pyromet CTX-1, Pyromet 31, tensile properties, creep rupture, microstructure

12. **Evaluation of Cyclic Behavior of Aircraft Turbine Disk Alloys**
Shahani, V., Popp, H. G.
General Electric Co., Aircraft Engine Group, Evendale, OH
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Key Words: RENE' 95, Inconel 718, aircraft structures, turbine components, fatigue, fracture mechanics, crack growth, creep rupture, tensile properties

13. **Forging and Powder Metallurgy Processing**
Fischmeister, H., Straube, H.
Applied Sciences Publishers Ltd., London, UK
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Key Words: Nimonic 90, Udimet 520, Udimet 700, Inconel 718, IN-738, IN-100, turbine components, microstructure, creep properties, tensile properties, fatigue, precipitation, thermomechanical treatment

14. **Review of Advanced Powder Metallurgical Fabrication Techniques in European NATO Countries**
Sutcliffe, P. W.
Advisory Group for Aerospace Research and Development, Paris, France
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Key Words: IN-100, IN-738, Alloy 713, Inconel 718, RENE' 95, Ti-6Al-4V, Waspaloy, precipitation hardening

15. **Materials for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S.
General Electric Co., Aircraft Engine Group, Evendale, OH
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16. **Atomised Powder-The Key to New Alloys**
Wallis, P. B.
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Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

17. **Nickel Superalloy Powder Production and Fabrication to Turbine Discs**
Symonds, C. H., Thompson, F. A.
Wiggins (Henry) and Co. Ltd., Hereford, UK
Proc 42nd Meeting of the AGARD Structures and Materials Panel
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Bryant, W. A., Weld J 54 (12), 433-S-435-S, 1975 (AD-D102 316)
Key Words: AISI 4340, MAR-M250, AISI 1020, 9Ni-4Co steel, Inconel 718, diffusion welding, dissimilar joint, temperature effect, modulus of elasticity, melting point
20. **Modern Methods of Powder Metallurgical Processing of Superalloys**
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Brown, Boveri & Co. Ltd., Baden, Switzerland
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Key Words: Udimet 500, Hastelloy X, X-45, Udimet 710, IN-100, IN-853 Udimet 700, RENE' 95, Inconel 718, D-979, Nimonic 80A, TD-nickel, turbine components, creep rupture, tensile properties, fatigue, atomization, REP, thermomechanical treatment
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Havel, C. J., Kelsey-Hayes Co., Utica, NY
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Kaieda, Y., Trans Natl Res Inst Metals 28(3), 224-30, 1986 (AD-D138 855)
Key Words: IN-738, MA6000, MA753, turbine components, creep rupture
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Singer, R. F., Powder Metall Int 17 (6), 284-8, 1985 (AD-D134 736)
Key Words: IN-738, MA6000, turbine components, tensile properties, dispersion strengthening
3. **The Effects of Small Deformation on Creep and Stress Rupture Behavior of ODS Superalloys**
Nardone, V. C., Matejczyk, D. E., Tien, J. K.
Henry Krumb School of Mines, NY
Rept No : AFOSR-TR-83-0095, 58 pp., 1983 (AD-A125 640)
Key Words: Udimet 700, MA754, MA6000, oxide dispersoids, notch toughness, crack propagation, fatigue, creep deformation

4. **The State of the Science and Art of Powder Metallurgy**
 Lenel, F. V., Ansell, G. S., J Met 34 (2), 17-29, 1982 (AD-D124 400)
Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile properties, sintering

5. **Recent Developments in Powder Metallurgy of Superalloys**
 Gessinger, G. H., Powder Metall Int 13 (2), 93-101, 1981 (AD-D122 017)
Key Words: MERL 76, Udimet 700, RENE' 95, IN-738, MA6000E, MAR-M200, mechanical properties, corrosion, superplastic forming, thermomechanical treatment

6. **Creep Deformation and Rupture of Oxide Dispersion Strengthened Inconel MA754 and MA6000E**
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 Proc 4th Int Symp Superalloys, Superalloys 1980, 563-73, 1980 (AD-D120 685)
Key Words: MA754, MA6000E, deformation, creep rupture, notch sensitivity, dispersion hardening

MAR-M200

1. **Flow Behavior of Nickel-Base Superalloys at Isothermal Forging Temperatures and Strain Rates**
 Immarigeon, J-P., Koul, A. K., Pergamon Press, Elmsford, NY
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Key Words: IN-100, MAR-M200, Alloy 713LC, grain size, deformation, flow properties

2. **Trends in Superalloy Powder Processing**
 Immarigeon, J-P., Wallace, W.
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Key Words: Alloy 713LC, MAR-M200, microstructure, grain size, net shape forming

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 Lenel, F. V., Ansell, G. S.
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4. **Development of Hybrid Gas Turbine Bucket Technology**
 Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
 General Electric Co., Gas Turbine Division, Schenectady, NY
 Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 054)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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 Tien, J. K., Howson, T. E.
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7. **On the Hydrostatic Extrusion of Nickel-Based Superalloys**
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 Key Words: MAR-M200, microhardness, aging, heat treatment, extrusion

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 Cox, A. R., Moore, J. B., Van Reuth, E. C.
 Pratt and Whitney Aircraft Group, West Palm Beach, FL
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 Key Words: MAR-M200, IN-100, tensile properties, creep properties, rapid solidification, recrystallization

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 Key Words: MAR-M200, compressive properties, fracture mechanics, particle size

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 United Technologies Corp., West Palm Beach, FL
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 Key Words: MAR-M200, IN-100, 7Ni steel, 9Ni steel, turbine components, airfoils, rapid solidification, atomization, recrystallization, thermal stability

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 Patterson, R. J.
 United Technologies Corp., West Palm Beach, FL
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 Key Words: MAR-M200, IN-100, Co-20Cr, airfoils, tantalum addition, microstructure, particle size, atomization

12. **Control of Grain Structure during Superalloy Powder Processing**
 Wallace, W., Immarigeon, J-P. A., Trenouth, J. M., Powell, B. D.
 National Aeronautical Establishment, Ottawa, Canada
 p.9-1 to p.9-13, 1976 (AD-D110 187)
 Key Words: Alloy 713LC, MAR-M200, IN-100, MAR-M246, Udimet 700
 microstructure, tensile properties, creep rupture, gamma prime, thermomechanical treatment, temperature effect

MERL 76

1. **The Production and Processing of High-Quality Powder Metallurgy Materials**
Graf, W., Kraemer, H. J., Poetschke, J., Weiglin, W.
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Key Words: T-15, M-4, M-50, AISI 304, AISI 316, AISI 321, AISI 410, AISI 440, Udimet 700, MERL 76, IN-100, Stellite 6, Stellite 1, Stellite 12, Stellite 21, atomization, particle size, density, creep, metal injection molding
2. **Mechanical Properties of Powder Ni-Base Superalloy Consolidated by HIP**
Takigawa, H., Iwai, K., Kawai, N., Kokomaku, T.
J Jpn Soc Powder Powder Metall 33 (5), 251-6, 1986 (AD-D135 711)
Key Words: MERL 76, IN-100, AF-115, creep rupture, tensile properties, fatigue
3. **Structure and Properties of a Rapidly Solidified Superalloy Produced by Liquid Dynamic Compaction**
Ogata, K., Lavernia, E., Ral, G., Grant, N. J.
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Key Words: MERL 76, IN-100, microstructure, tensile properties, rapid solidification
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Morishita, M., Nagai, H., Shoji, K.
J Jpn Soc Powder Powder Metall 33 (7), 373-8, 1986 (AD-D136 163)
Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture
5. **Properties and Microstructures for Dual Alloy Combinations of Three Superalloys with Alloy 901**
Harf, F. H.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
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Key Words: Incoloy 901, RENE' 95, MERL 76, Udimet 700, turbine components, microstructure, tensile properties, creep rupture, joining
6. **Prior Particle Boundary Precipitation in P/M Superalloys**
Thamburaj, R., Koul, A. K., Wallace, W., de Malherbe, M. C.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy 16, 635-73, 1985 (AD-D138 354)
Key Words: Udimet 700, AF-115, IN-792, MAR-M432, MERL 76, PA 101, RENE' 41, tensile properties, creep rupture, fatigue
7. **Experimental and Theoretical Studies of Creep Crack Growth**
Pelloux, R. M., Bain, K. R., Bensussan, P.
Massachusetts Institute of Technology, Cambridge, MA
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Rept No : AFOSR-TR-84-0387, 146 pp., 1984 (AD-A141 193)
Key Words: AA 2219-T851, Udimet 700, MERL 76, IN-100, RENE' 95, creep, cracking, tensile properties, creep rupture

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Prybylowski, J., Pelloux, R. M., Price, P.
Powder Metall 27 (2), 107-11, 1984 (AD-D130 603)
Key Words: MERL 76, microstructure, creep, cracking, creep rupture, tensile properties, notch properties

9. **Effect of Oxygen on Creep Crack Growth in PM/HIP Nickel-Base Superalloys**
Bain, K. R., Pelloux, R. M.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984, 387-96, 1984 (AD-D132 853)
Key Words: Udimet 700, MERL 76, IN-100, RENE' 95, grain boundaries, notch properties, aging, embrittlement

10. **Welding of PM Superalloys**
Wilhelm, H.
NTIS, N85-16191, Springfield, VA
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Rept No : MTU-TB-910/84, 66 pp., 1984 (AD-D133 633)
Key Words: Udimet 700, IN-100, RENE' 95, MERL 76, weld and post weld, tensile properties, fatigue

11. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Quarterly Technical Progress Report Number Twenty Four, Dec 81-Feb.82
Contract No : NAS 3-20072
44 pp., 1982 (AD-D124 466)
Key Words: MERL 76, Hastelloy X, Incoloy 901, AMS 5616, AMS 4928, MA956, JT-9D, JT-8D, turbine components, coatings, erosion, fatigue

12. **Hot Isostatically Pressed Manufacture of High Strength MERL 76 Disk and Seal Shapes**
Eng, R. D., Evans, D. J.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Final Report
Rept No : NASA-CR-165549, 138 pp., 1982 (AD-D125 120)
Key Words: MERL 76, Waspaloy, turbine components, tensile properties, creep, fatigue, notch sensitivity

13. **Hot Isostatically Pressed Manufacture of High Strength MERL 76 Disk and Seal Shapes, Volume 2**
Evans, D. J.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Final Rept, Project 2
Rept No : NASA-CR-165550, 11 pp., 1982 (AD-D126 061)
Key Words: IN-100, MERL 76, JT-9D, turbine components, fatigue, net shape forming, nondestructive testing

14. **High Temperature Aerospace Materials Prepared by Powder Metallurgy**
Thompson, E. R.
Annual Reviews Inc., Palo Alto, CA
Annual Review of Materials Science (book) 12, 213-42, 1982 (AD-D126 273)
Key Words: IN-100, Udimet 700, RENE' 95, MERL 76, Ti-6Al-4V, creep rupture, fatigue, fracture toughness

15. **Recent Developments in Powder Metallurgy of Superalloys**
 Gessinger, G. H.
 Powder Metall Int 13 (2), 93-101, 1981 (AD-D122 017)
Key Words: MERL 76, Udimet 700, RENE' 95, IN-738, MA6000E, MAR-M200,
 mechanical properties, corrosion, superplastic forming, thermomechanical treatment

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 Pratt and Whitney Aircraft Group, East Hartford, CT
 Quarterly Technical Progress Report Number Twenty Two, Jun.-Aug. 1981
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 36 pp., 1981 (AD-D122 325)
Key Words: Hastelloy X, MA956, Udimet 700, MERL 76, turbine components,
 combustor liners, airfoils, coatings, fatigue, erosion resistance

17. **Microstructural Behavior of Interfaces in Hot Isostatically Pressed Dual Alloy Combinations**
 Harf, F. H.
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 Technical Memorandum
 Rept No : NASA-TM-82698, 10 pp., 1981 (AD-D122 440)
Key Words: MERL 76, Udimet 700, RENE' 95, turbine components, microstructure,
 phase studies, prealloying, interface

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 Moll, J. H.
 Mech Eng 103 (11), 56-61, 1981 (AD-D122 795)
Key Words: RENE' 95, titanium alloys, tool steel, Udimet 700, IN-100, MERL
 76, Waspaloy, turbine components, microstructure, tensile
 properties, stress intensity

19. **Plastic Flow and Fracture Processes in Powder Metallurgical Nickel- Base Superalloys**
 Law, C. C., Blackburn, M. J.
 Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
 Final Report
 Rept No : PWA-FR-13317, 134 pp., 1980 (AD-A086 697)
Key Words: AF-115, MERL 76, MAR-M432, microstructure, tensile properties,
 notch properties, fatigue, creep, plastic deformation

20. **Manufacture of Disks by the Hot Isostatic Pressing Process**
 Cassenti, B. N.
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Key Words: MERL 76, turbine components, creep properties, modelling

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Key Words: MERL 76, modelling, tensile properties, creep properties,
 compression tests

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 Law, C. C., Blackburn, M. J.
 Metall Trans 11A (3), 495-507, 1980 (AD-D117 895)
Key Words: AF-115, MAR-M432, IN-100, MERL 76, creep properties, tensile properties, lattice parameters, grain boundaries, heat treatment

23. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A., Blecherman, S. S.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Sixteen, Dec 79-Feb-80
 Contract No : NAS3-20072
 44 pp., 1980 (AD-D118 687)
Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, tensile properties, creep rupture, coatings, plasma deposition, dispersion hardening

24. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Seventeen, 1 Mar-31 May 1980
 Contract No : NAS 3-20072
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Key Words: MERL 76, Haynes 8077, MA956, turbine components, combustor liners, compressor components, airfoils, fatigue, creep properties, coatings, mechanical properties

25. **Evaluation of the Cyclic Behavior of Aircraft Turbine Disk Alloys, Part 2**
 Cowles, B. A., Warren, J. R., Haake, F. K.
 Pratt and Whitney Aircraft Group, West Palm Beach, FL
 Final Report
 Rept No : PWA-FR-13153, 191 pp., 1980 (AD-D119 421)
Key Words: MERL 76, RENE' 95, IN-100, Waspaloy, Udimet 700, NASA IIB-7 fatigue crack growth, creep-fatigue, tensile properties, microstructure

26. **Application of Superalloy Powder Metallurgy for Aircraft Engines**
 Dreshfield, R. L., Miner, R. V., Jr.
 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
 Technical Memorandum
 Rept No : NASA-TM-81466, 21 pp., 1980 (AD-D119 422)
Key Words: RENE' 95, Udimet 700, MERL 76, turbine components, tensile properties, creep properties, fatigue

27. **Materials for Advanced Turbine Engine-MATE**
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 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Eighteen, 1 Jun-31 Aug 1980
 Contract No : NAS 3-20072
 47 pp., 1980 (AD-D119 486)
Key Words: MERL 76, MA956, Hastelloy X, turbine components, tensile properties, fatigue, coatings

28. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number nineteen, 1 Sept-30 Nov 1980
 Contract No : NAS 3-20072
 35 pp., 1980 (AD-D120 344)
Key Words: MERL 76, Haynes 8077, MA956, aircraft engines, turbine components,
 combustor liners, compressor components, airfoils, fatigue,
 net shape forming, coatings

29. **High Strength HIP Consolidated MERL 76 Disks**
 Eng, R. D., Evans, D. J.
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 tensile properties, creep properties, dispersion hardening

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1. **Effects of C and Hf Concentration on Phase Relations and Microstructure of a Wrought Powder-Metallurgy Superalloy**
Miner, R. V., Jr.
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Key Words: NASA IIB-11, carbon addition, hafnium addition, turbine components, microstructure, phase studies, gamma prime, carbide precipitation
2. **Development of an Extra-High Strength Powder Metallurgy Nickel-Base Superalloy**
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Key Words: NASA IIB-11, turbine components, thermal stability, microstructure, creep rupture, tensile properties, grain size, heat treatment

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1. **Hot Isostatic Press**
 Author Anon, Foreign Technology Division, Wright-Patterson AFB, OH
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 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125,
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 properties, unidirectional solidification, dissimilar joining,
 diffusion bonding, creep rupture

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Key Words: TMP-1, TMP-9, TMP-2, RENE' 95, TMP-3, TMP-4, TMP-10, TMP-11
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 phase, boron addition, carbon addition, heat treatment, aging,
 tensile properties

2. **Effect of Preliminary Heat Treatment on Microstructure of P/M RENE' Superalloy**
 Mao, J., Yu, K., Zhou, R.
 Foreign Technology Division, Wright-Patterson AFB, OH
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 Rept No : FTD-ID(RS)T-1058-90, 7 (4), 213-9, 1989 (AD-A237 176)
Key Words: RENE' 95, heat treatment, grain boundaries, carbides, gamma prime
 phase, grain size

3. **The Deformation Behavior of P/M RENE' 95 Under Isothermal Forging Conditions**
 Morra, J.M., Biederman, R.R., Tuler, F.R.
 The Metallurgical Society of AIME, Warrendale, PA
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Key Words: RENE' 95, microscopy, deformation, isothermal forging, flow
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 MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Udimet 700, Inconel 625, RENE' 95, H-13 tool steel, precipitation
 hardening, tensile properties, thermal expansion, hardness, creep

5. **Effects of Gamma-Prime Phase Content in RENE-95 and Its Derivative Alloys on Parameters of Superplasticity and High Temperature Tensile Properties--1. Superplasticities and Tensile Strengths of the Rods Extruded from HIP-Consolidated Alloy Powder**
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Key Words: RENE' 95, tensile properties, elongation, superplasticity

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Key Words: RENE' 95, tensile properties, forging, thermal expansion

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 Center for Strategic Materials, Henry Krumb School of Mines, NY
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Key Words: RENE' 95, Inconel 718, near net forming, tensile properties,
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Key Words: RENE' 95, particle size, stress-strain, creep deformation,
 activation energy, plastic flow

10. **Modern Powder Metallurgy Science and Technology**
 Lawley, A.
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Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP,
 tensile properties, impact toughness

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Center for Strategic Materials, Columbia University, NY
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Cockell, M. W., Boyce, K. A. G.
Met Powder Rept 40 (3), 139-44, 1985 (AD-D132 551)
Key Words: Nimonic AP1, Udimet 700, RENE' 95, turbine components, grain size, tensile properties, creep rupture, fatigue

13. **Properties and Microstructures for Dual Alloy Combinations of Three Superalloys with Alloy 901**
Harf, F. H.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
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Key Words: Incoloy 901, RENE' 95, MERL 76, Udimet 700, turbine components, microstructure, tensile properties, creep rupture, joining

14. **Effect of Inclusions on LCF Life of HIP Plus Heat Treated Powder Metal RENE' 95**
Shamblen, C. E., Chang, D. R.
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Key Words: RENE' 95, microstructure, crack propagation, fatigue

15. **Experimental and Theoretical Studies of Creep Crack Growth**
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Key Words: AA 2219-T851, Udimet 700, MERL 76, IN-100, RENE' 95, creep, cracking, tensile properties, creep rupture

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Kissinger, R. D., Nair, S. V., Tien, J. K.
Henry Krumb School of Mines, NY
Interim Report
Rept No : AFOSR-TR-85-0676, 8 pp., 1984 (AD-A158 419)
Key Words: RENE' 95, microstructure, particle size, modelling

17. **Effect of Environment on Creep Crack Growth in PM/HIP RENE-95**
Bair, K. R., Pelloux, R. M.
Metall Trans 15A (2), 381-8, 1984 (AD-D129 273)
Key Words: RENE' 95, Inconel 718, IN-100, Inconel X-750, Udimet 700, creep, crack growth, fractography

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Wigotsky, V.
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Key Words: Ti-6Al-4V, RENE' 95, AA 7090, AA 7091, Al-8Fe, turbine components, shear properties, compressive properties, net shape forming

19. **Superalloy Powder Processing, Properties and Turbine Disk Applications**
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Key Words: RENE' 95, microstructure, tensile properties, fatigue crack

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Key Words: RENE' 95, particle size, deformation, plastic strain

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Key Words: RENE' 95, turbine components, microstructure, deformation, oxidation, fatigue strain, plastic strain

23. **The Influence of Hold Times on LCF and FCG Behavior in a P/M Ni-base Superalloy**
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Key Words: RENE' 95, microstructure, fracture surface, oxidation, creep test, fatigue

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Key Words: Udimet 700, MERL 76, IN-100, RENE' 95, grain boundaries, notch properties, aging, embrittlement

25. **Liquid Phase Sintering of Nickel Base Superalloys**
 Jeandin, M., Bienvenu, Y., Koutny, J. L.
 The Metallurgical Society of AIME, Warrendale, PA
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Key Words: Nimonic AP1, Udimet 700, RENE' 95, molybdenum addition, chromium addition, microstructure, tensile strength, creep rupture

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 Wilhelm, H.
 NTIS, N85-16191, Springfield, VA
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 Rept No : MTU-TB-910/84, 66 pp., 1984 (AD-D133 633)
Key Words: Udimet 700, IN-100, RENE' 95, MERL 76, weld and post weld, tensile properties, fatigue

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 Shamblen, C. E.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Final Report Jan 79-Dec 82
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 Key Words: RENE' 95, fatigue, tensile properties, creep rupture, microprobe analysis

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 Key Words: AA 7090, AA 7091, IN9052, Ti-6Al-4V, Monel 400, Inconel 600, RENE' 95, Cb291, Udimet 700, IN-100, AF-115, Inconel 625, net shape forming, injection molding, applications, forging

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 Key Words: RENE' 95, Udimet 700, porosity, grain boundaries, precipitation, particle size, grain size, sintering

30. **Fatigue Crack Growth and Low Cycle Fatigue of Two Nickel Base Superalloys**
 Stoloff, N. S., Duquette, D. J., Choe, S. J., Golwalker, S.
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 Key Words: RENE' 95, Udimet 700, fatigue, cracking, tensile properties

31. **PM Dual Property Wheels for Small Engines**
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 Key Words: C-103, PA 101, MAR-M247, RENE' 95, turbine components, joining, unidirectional solidification

32. **Long Life Disks from Rapidly Solidified Materials. Volume 1 RENE' 95 and AF115 Process Development**
 Van Stone, R. H.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Final Report Jul 78-Sep 81
 Rept No : AFWAL-TR-82-4032-Vol-1, 301 pp., 1982 (AD-B080 374L)
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33. **Long Life Disks from Rapidly Solidified Materials. Volume 2 Powder Metallurgy Alloy Development**
 Van Stone, R. H.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Final Report Jul 78-Sep 81
 Rept No : AFWAL-TR-82-4032-Vol-2, 215 pp., 1982 (AD-B080 375L)
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 Final Report Jul 78-Sep 81
 Rept No : AFWAL-TR-82-4032-Vol-3, 154 pp., 1982 (AD-B080 376L)
Key Words: AF-115, RENE' 95, rapid solidification, melt spinning, fatigue
 crack growth, creep rupture, replica technique

35. **Hot Isostatic Processing**
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Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1,
 M-2, B-1900, MAR-M250, welding, fatigue, tensile properties, heat treatment

36. **Superalloys More Super Than Ever**
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Key Words: RENE' 95, IN-100, AISI 316, microstructure, recrystallization,
 creep rupture, oxidation, tensile properties

37. **PM Technology Hitting New Highs**
 McIntyre, R. D.
 Mater Eng 95 (4), 46-54, 1982 (AD-D124 504)
Key Words: RENE' 95, IN-100, Ti-6Al-4V, Ti-6Al-6V-2Sn, coatings, phase
 transformation, net shape forming

38. **High Temperature Aerospace Materials Prepared by Powder Metallurgy**
 Thompson, E. R.
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Key Words: IN-100, Udimet 700, RENE' 95, MERL 76, Ti-6Al-4V, creep rupture,
 fatigue, fracture toughness

39. **Superalloys from Powder: Production and Properties**
 Author Anon
 National Materials Advisory Board (NAS-NAE), Washington DC
 Final Report
 Rept No : NMAB-369, 102 pp., 1981 (AD-B058 349L)
Key Words: RENE' 95, X-40, Maraging 300, turbine components, fatigue, rapid
 solidification, mechanical properties, atomization

40. **Processing Effects on the Microstructure and Fatigue Properties of Nickel-Base Superalloys**
 Van Stone, R. H., Henry, M. F.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Progress Report Number 2, Nov 80-Feb 81
 Contract No : N62269-80-C-0708
 59 pp., 1981 (AD-D121 677L)
Key Words: RENE' 95, turbine components, tensile properties, compressive
 stress, crack nucleation, replica technique

41. **Powder Metallurgy RENE' 95 Rotating Turbine Engine Parts-MATE**
 Redden, T. K., Wilbers, L. G.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Final Report, Project 1-Volume 2
 Rept No : R80AEG664, 31 pp., 1981 (AD-D120 726)
Key Words: RENE' 95, turbine components, compressor components, tensile properties, net shape forming

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 Gessinger, G. H.
 Powder Metall Int 13 (2), 93-101, 1981 (AD-D122 017)
Key Words: MERL 76, Udimet 700, RENE' 95, IN-738, MA6000E, MAR-M200, mechanical properties, corrosion, superplastic forming, thermomechanical treatment

43. **Microstructural Behavior of Interfaces in Hot Isostatically Pressed Dual Alloy Combinations**
 Harf, F. H.
 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
 Technical Memorandum
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Key Words: MERL 76, Udimet 700, RENE' 95, turbine components, microstructure, phase studies, prealloying, interface

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 Moll, J. H.
 Mech Eng 103 (11), 56-61, 1981 (AD-D122 795)
Key Words: RENE' 95, titanium alloys, tool steel, Udimet 700, IN-100, MERL 76, Waspaloy, turbine components, microstructure, tensile properties, stress intensity

45. **Development of Materials and Process Technology for Dual Alloy Disks**
 Marder, J. M., Kortovich, C. S.
 TRW Inc., Materials Lab, Cleveland, OH
 Final report
 Rept No : TRW-ER-8000F, 175 pp., 1981 (AD-D124 206)
Key Words: RENE' 95, AF-115, tensile properties, fatigue, creep rupture

46. **Long Life Engine Disks from Gas Atomized Powder**
 Van Stone, R. H.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Quarterly Report Nov 79-Jan 80
 Contract No : F33615-78-C-5100
 61 pp., 1980 (AD-B052 434L)
Key Words: RENE' 95, hardness, tensile properties, creep rupture

47. **Long Life Engine Disks from Gas Atomized Powder**
 Van Stone, R. H., Carlson, D. M.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Quarterly Report Feb-Jul 80
 Contract No : F33615-78-C-5100
 84 pp., 1980 (AD-B053 077L)
Key Words: RENE' 95, AF-115, rapid solidification, fatigue, cracking, tensile properties

48. **Investigation of the Influence of Metallurgical Factors on the Fatigue Behavior of Gas Turbine Disk Alloys**
Van Stone, R. H.
General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Progress Letter Report Number One, Dec 79-Mar 80
Contract No : N00019-79-C-0659
12 pp., 1980 (AD-D118 800L)
Key Words: RENE' 95, fatigue tests, fabrication, heat treatment
49. **Investigation of the Influence of Metallurgical Factors on the Fatigue Behavior of Gas Turbine Disk Alloys**
Van Stone, R. H., Henry, M. F., Ritter, A. M.
General Electric Co., Aircraft Engine Group, Evendale, OH
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solidification, fatigue, creep rupture, tensile properties,
fracture surface, temperature effect

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Key Words: RENE' 95, RENE' 150, turbine components, unidirectional
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Udimet 700

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Key Words: Udimet 700, microscopy, rupture strength, creep, aging, tensile
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 Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Udimet 700, cobalt addition, chromium addition, molybdenum addition, aluminum addition, heat treatment, creep rupture, tensile properties

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Key Words: IN-100, Udimet 700, microstructure, creep rupture, porosity, intergranular fracture, splat quenching

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Key Words: IN-100, Udimet 700, turbine components, fabrication, gatorizing, ultrasonic testing

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Key Words: Nimonic 75, Nimonic 80A, Nimonic 81, Nimonic 90, Nimonic 105, Nimonic 115, Incoloy 901, Nimonic PE11, Nimonic PE16, Nimonic 263, Inconel 718, Inconel X-750, Nimocast 80, Nimocast 242, Nimocast 263, Alloy 713C, Alloy 713LC, Nimocast PD21, Nimocast PE10, Nimocast PK24, IN-738, turbine components

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Key Words: Alloy 713LC, MAR-M200, IN-100, MAR-M246, Udimet 700 microstructure, tensile properties, creep rupture, gamma prime, thermomechanical treatment, temperature effect

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 Evans, D. J.
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Key Words: IN-100, Udimet 500, MAR-M246, Udimet 700, TD-nickel, chromium
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Key Words: AF-95, VHP, microstructure, creep properties, fracture toughness,
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TITANIUM AND TITANIUM ALLOYS

Titanium

1. **Advanced Powder Metallurgy Techniques for Both Economic Advantage and for Property Enhancement of Titanium Alloys and Titanium Matrix Composites**
Abkowitz, S. M., Abkowitz, S.
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Key Words: titanium, hardness, cost
2. **Densification of Titanium Powder during Hot Isostatic Pressing**
Lograsso, B. K., Koss, D. A.
Department of Materials Science and Engineering, Pennsylvania State University,
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Key Words: titanium, plasma deposition, REP, porosity, density,
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3. **Advanced Processing and Properties of High Performance Alloys**
Koss, D. A.
Department of Materials Science and Engineering, Pennsylvania State University,
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Key Words: titanium, Ti-10Al, AA 7075, AA 1100, erbium addition, porosity,
voids, rapid solidification, fatigue, deformation, fracture mechanics
4. **Effects of Purity of Titanium Powder and Porosity on Static Tensile Properties of Sintered and Titanium Specimens**
Majima, K., Hirata, T., Shouji, K.
J Jpn Inst Met 51 (12), 1194-200, 1987 (AD-D138 267)
Key Words: titanium, microstructure, compaction, tensile properties
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Key Words: Ti-6Al-4V, titanium, mechanical properties
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Highberger, W.T., Chanani, G.R., Scarich, G.V.
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Key Words: titanium, Corona-5, F-14 aircraft, F-18 aircraft, crack
propagation, near net shape, fatigue

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Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics
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Corona-5

1. **Fatigue property Enhancement of Alpha-Beta Titanium Alloys by Blended Elemental P/M Approach**
 Hagiwara, M., Kaieda, Y., Kawabe, Y., Miura, S.
 Iron Steel Inst Jpn Inter 31 (8), 922-30, 1991
Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties
2. **Advanced Titanium Metallic Materials and Processes for Application to Naval Aircraft Structures**
 Highberger, W. T., Chanani, G. R.
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Key Words: Ti-6Al-4V, Corona-5, aircraft structures, F-14 aircraft, fatigue, crack growth, tensile properties, superplastic forming, cost
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Key Words: Corona-5, microstructure, electron beam welding, welds, fracture toughness, fatigue, fractography, tensile properties, intergranular fracture
4. **Engineering Data for New Aerospace Materials**
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Key Words: AA 7010-T73651, Corona-5, AA A357-T6, IN-792, fatigue, bearing strength, tensile properties, thermal expansion

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 Materials 1980 : Proc 12th Natl SAMPE Tech Conf 12, 538-53, 1980 (AD-D312 945)
Key Words: titanium, Corona-5, F-14 aircraft, F-18 aircraft, crack propagation, near net shape, fatigue

Ti-5Al-2.5Sn

1. **On the Effects of NaCl on Porosity in Elemental-Blend Powder-Metallurgy Ti-5Al-2.5Sn**
 Jackson, A. G., Moteff, J., Froes, F. H.
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Key Words: Ti-5Al-2.5Sn, porosity, microstructure
2. **Transient Liquid Phase Sintering of P/M Titanium**
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Key Words: Ti-5Al-2.5Sn, Ti-6Al-6V-2Sn, density, sintering, net shape forming.
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Key Words: Ti-5Al-2.5Sn, microstructure, porosity, dispersion hardening, aging
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Key Words: Ti-6Al-4V, Ti-5Al-2.5Sn, silicon and germanium, porosity,dispersions

Ti-6Al-2Sn-4Zr-2Mo

1. **Fatigue property Enhancement of Alpha-Beta Titanium Alloys by Blended Elemental P/M Approach**
 Hagiwara, M., Kaieda, Y., Kawabe, Y., Miura, S.
 Iron Steel Inst Jpn Inter 31 (8), 922-30, 1991
Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties
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 Moll, John H., Yolton, C. F., McTiernan, B. J.
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Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

3. **P/M Titanium Technology for High Performance Uses**
Moll, J. H., Yolton, C. F., Chandhok, V. K.
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Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo, near net forming, REP, atomization, tensile properties, creep rupture
4. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
Anderson, R. E.
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Interim Technical Report Feb-Apr 87
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-1Mo-1V, Ti-6Al-2Sn-4Zr-2Mo, microscopy, porosity, tensile properties
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Birla, N. C., Krishnaswamy, W.
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Key Words: Ti-6Al-2Sn-4Zr-2Mo, microstructure, tensile properties, consolidation, explosive compaction
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Ti-6Al-2Sn-4Zr-6Mo

1. **Fabrication and Evaluation of Production-Size Quantities of Rapidly Solidified Ti-6Al-2Sn-4Zr-6Mo-.75Er**
Martin, R. L., Tarnacki, G.
TMS, Warrendale, PA
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, erbium addition, turbine components, airframes, rapid solidification, gas atomization, production, extrusion, forging, tensile properties, fracture toughness, creep
2. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
Anderson, R. E., Martin, R. L.
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, alloy development, machining, forging, rapid solidification
3. **High Temperature Rapidly Solidified Titanium Alloy Evaluation**
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, Ti-8Al-1Mo-1V, Ti-6Al-2Sn-4Zr-2Mo, microscopy, porosity, tensile properties

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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

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 Chen, C. C.
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, tensile properties, fracture toughness

6. **Hot Isostatic Pressing of Large Titanium Shapes**
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Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, aircraft structures, engine components, tensile properties, net shape forming

7. **Manufacturing Methods for Production of Titanium Alloy Compressor Disks from Powder Billet**
 Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
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Key Words: Ti-6Al-2Sn-4Zr-6Mo, microstructure, tensile properties, fatigue, creep, gatorizing

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Key Words: Ti-6Al-2Sn-4Zr-6Mo, turbine components, microstructure, forging, fracture, gatorizing, tensile properties, creep rupture

Ti-6Al-4V

1. **Fatigue property Enhancement of Alpha-Beta Titanium Alloys by Blended Elemental P/M Approach**
 Hagiwara, M., Kaieda, Y., Kawabe, Y., Miura, S.
 Iron Steel Inst Jpn Inter 31 (8), 922-30, 1991
Key Words: IMI 829, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, Corona-5 Ti-5Al-2Cr-1Fe, Ti-5Al-2.5Fe, microstructure, fatigue life crack initiation, tensile properties

2. **Powder Metallurgy of Titanium Alloys**
 Froes, F. H., Eylon, D.
 Int Mater Rev 35 (3), 162-82, 1990 (AD-D144 188)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, microstructure, crack growth, fatigue, fracture toughness, tensile properties, porosity, near net shape

3. **Effect of Degassing Treatment on Microstructure and Mechanical Properties of P/M Ti-6Al-4V**
Lee, Y. T., Schurmann, H., Grundhoff, K. J., Peters, M.
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Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, fracture toughness

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Kearns, M. W., Blenkinsop, P. A., Barber, A. C., Farthing, T. W.
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Key Words: Ti-6Al-4V, consolidation, damping, hot working

5. **P/M Titanium Technology for High Performance Uses**
Moll, J. H., Yolton, C. F., Chandhok, V. K.
Ind Heat 55 (5), 24-30, 1988 (AD-D138 992)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-2Mo, near net forming, REP, atomization, tensile properties, creep rupture

6. **Production of Powder Ti-Alloy Rings by Means of Compaction and Radial-Rolling**
Szczepanik, S., Kopp, R., Wiegels, H.
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Key Words: Ti-6Al-4V, microstructure, deformation, fracture surface, rolling, forging

7. **Effect of High Pressure Compaction on Phase Morphology of Alpha/Beta Titanium Alloys**
Locci, I. E., Welsch, G., Eylon, D., Froes, F. H.
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Key Words: Ti-6Al-4V, microstructure, fracture surface, REP, plastic deformation

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MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Ti-6Al-4V, ingot metallurgy, near net shape, REP, plasma deposition, fatigue stress

9. **Effect of Thermomechanical Treatment on the Fatigue Behavior of PM Ti-6Al-4V Containing Artificial Contaminants**
Wirth, G., Grundhoff, K. J., Eylon, D., Froes, F. H.
MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Ti-6Al-4V, REP, fatigue stress, fracture,

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Lee, Y. T., Grundhoff, K. J., Wirth, G.
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Key Words: Ti-6Al-4V, microstructure, fatigue crack, PREP, aging, tensile properties

11. **Characteristic Properties of Hot Isostatically Pressed Ti-6Al-4V Alloys**
Majima, K., Hirata, T., Yamamoto, M., Shoji, K.
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Key Words: Ti-6Al-4V, microstructure, fractography, REP, tensile properties

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 Sheinker, A. A., Chanani, G. R., Bohlen, J. W.
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Key Words: Ti-6Al-4V, F-18A aircraft, corrosion, REP, tensile properties, shear, fracture toughness

13. **Advanced Processing and Properties of High-Performance Alloys**
 Koss, D. A.
 Department of Metallurgical Engineering, Michigan Tech University, Houghton
 Technical Report Number Four
 Contract No : N00014-85-K-0427
 19 pp., 1986 (AD-A167 404)
Key Words: Ti-6Al-4V, AA 7075-T6, AA 1100, AISI 316, fabrication, rapid solidification

14. **Correlations Between Post-HIP Treatment, Resulting Microstructure, and Fatigue Behavior of Prealloyed Ti-6Al-4V Powder Compacts**
 Wirth, G., Grundhoff, K. J., Smarsly, W.
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Key Words: Ti-6Al-4V, microstructure, TEM, tensile properties, fatigue stress

15. **Influence of Foreign Particles on Fatigue Behavior of Ti-6Al-4V Prealloyed Powder Compacts**
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Key Words: Ti-6Al-4V, alumina addition, silica addition, crack propagation, tensile properties, fatigue stress

16. **Improvement of Mechanical Properties of Blended Elemental Ti-6Al-4V Alloy Through Microstructural Modification**
 Haziwara, M., Kaieda, Y., Kawabe, Y.
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Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fatigue stress

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Key Words: Ti-6Al-4V, turbine components, microstructure, aging, beta processing, tensile properties, fatigue crack

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 Abkowitz, S., Rowell, D.
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Key Words: Ti-6Al-4V, turbine components, microstructure, net shape forming, tensile properties, fatigue

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 The Metallurgical Society of AIME, Warrendale, PA
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Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, rapid solidification, REP, tensile properties, fatigue

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 Author Anon
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

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 Williams, B.
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Key Words: Ti-6Al-4V, TiN coatings, sputtering

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Key Words: Ti-6Al-4V, microstructure, REP, thermally induced porosity

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Key Words: Ti-6Al-4V, microstructure, oxide addition

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Key Words: Ti-6Al-4V, microstructure, fracture surface, crack propagation, tensile properties, fatigue

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 Wirth, G., Grundhoff, K. J.
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Key Words: Ti-6Al-4V, microstructure, fracture, fatigue crack, tensile properties

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Key Words: Ti-6Al-4V, microstructure, near shape forming, forging

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 Grundhoff, K. J., Wirth, G.
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Key Words: Ti-6Al-4V, crack propagation, tensile properties, fatigue

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Key Words: Ti-6Al-4V, fracture, tensile properties, fatigue, REP

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Key Words: Ti-6Al-4V, tensile properties, shot peening, heat treatment

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 Buhl, H.
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 Koss, D. A.
 Department of Metallurgical Engineering, Michigan Tech University, Houghton
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Key Words: Ti-6Al-4V, Stellite 6, WC coating, diffusion welding and bonding

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 fatigue stress

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Key Words: Ti-6Al-4V, stress intensity factor, fracture surface, fatigue, crack growth

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Nyce, A. C.
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Key Words: AISI 4650, M-2, AISI 316L, Ti-6Al-4V, Monel 400, Stellite 6, Stellite 21, applications, cost, density, tensile properties

55. **Influence of Thermomechanical Processing on Low Cycle Fatigue of Prealloyed Ti-6Al-4V Powder Compacts**
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American Institute of Aeronautics and Astronautics, New York, NY
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Key Words: Ti-6Al-4V, turbine components, REP, net shape forming, tensile properties, fatigue stress, fracture toughness

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General Electric Co., Aircraft Engine Group, Evendale, OH
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Martin Marietta Aerospace, Orlando, FL
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Key Words: Ti-6Al-4V, tensile properties, impact tests, acceptance tests

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 Battelle Memorial Institute, Columbus, OH
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 corrosion, fatigue crack, tensile properties, compressive
 properties, thermal expansion, bearing strength

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 Metals Information Analysis Center, West Lafayette, IN
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Key Words: Ti-6Al-4V, IN-738, RENE' 95, Udimet 700, IN-792, Inconel 718, M-1,
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 J Met 34 (2), 17-29, 1982 (AD-D124 400)
Key Words: beryllium, MAR-M200, Ti-6Al-4V, MA67, MA6000E, steel, tensile
 properties, sintering

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 McIntyre, R. D.
 Mater Eng 95 (4), 46-54, 1982 (AD-D124 504)
Key Words: RENE' 95, IN-100, Ti-6Al-4V, Ti-6Al-6V-2Sn, coatings, phase
 transformation, net shape forming

64. **Recent Advancement in Titanium Near-Net Shape Technology**
 Chen, C. C.
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Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, net shape forming, cost

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 Annual Reviews Inc., Palo Alto, CA
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 fatigue, fracture toughness

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Key Words: AISI 4650, Stellite 6, AISI 316, Ti-6Al-4V, porosity, cost,
 tensile properties

67. **Advanced Manufacturing Methods for High Quality, Low Cost Titanium Powder
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 General Electric Co., Aircraft Engine Group, Evendale, OH
 Interim Engineering Progress Report Number Six , Dec 80-Sep 81
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Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, REP, tensile properties,
 fracture toughness

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 Key Words: Ti-6Al-4V, tensile properties, bearing strength, fracture
 toughness, compressive properties, stress corrosion

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 Martin Marietta Aerospace, Orlando, FL
 Contract No : DAAK10-78-C-0070, 161 pp., 1981 (AD-A125 345)
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 Key Words: Ti-6Al-4V, tensile properties, fatigue, net shape forming,
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 Highberger, W. T., Chanani, G. R.
 SAMPE Qtrly 12 (3), 32-9, 1981 (AD-D121 155)
 Key Words: Ti-6Al-4V, Corona-5, aircraft structures, F-14 aircraft, fatigue,
 crack growth, tensile properties, superplastic forming, cost

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 superplastic forming, diffusion bonding

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 properties, microstructure, density

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 Key Words: RENE' 95, AISI 316, M-2, Stellite 6, Ti-6Al-4V, AISI 410, jet
 engines, net shape forming

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 Froes, F. H., Eylon, D., Eichelman, G. E., Burte, H. M.
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 Key Words: Ti-6Al-4V, aircraft structures, turbine components, tensile
 properties, fatigue, microstructure, net shape forming

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 Andersen, P. J., Alber, N. E., Thellman, E. L.
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 Key Words: Ti-6Al-4V, net shape forming

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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

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Key Words: Ti-6Al-4V, fatigue, net shape forming, diffusion bonding

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 Metallurgical Society of AIME, Warrendale, PA
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Key Words: Ti-6Al-4V, helicopters, microstructure, fatigue, tensile properties, net shape forming

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 Metallurgical Society of AIME, Warrendale, PA
 Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
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Key Words: Ti-6Al-4V, prealloying, tensile properties, fracture toughness, fatigue, crack growth, crystallography, texture

81. **Titanium Net Shapes by a New Technology-Part 1: F-14A Parts Evaluation**
 Witt, R. H., Highberger, W.T.
 Metallurgical Society of AIME, Warrendale, PA
 Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
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Key Words: Ti-6Al-4V, aircraft structures, F-14A aircraft, fuselage, nacelle, net shape forming, tensile properties

82. **Titanium Net Shapes by a New Technology-Part 2: F-18A Parts Evaluation**
 Chanani, G. R., Highberger, W.T., Kelto, C. A.
 Metallurgical Society of AIME, Warrendale, PA
 Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
 3, 2314-19, 1980 (AD-D121 251)
Key Words: Ti-6Al-4V ELI, aircraft structures, F-18A aircraft, fractography, net shape forming, tensile properties, fatigue

83. **Isostatic Pressing of Complex Shapes from Titanium and Titanium Alloys**
 Abrowitz, S.
 Metallurgical Society of AIME, Warrendale, PA
 Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
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Key Words: Ti-6Al-4V, titanium, mechanical properties

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Key Words: Ti-6Al-4V, MERL 76, RENE' 95, aircraft structures, tensile properties, creep rupture

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Key Words: Ti-6Al-4V, tensile properties, particle size

86. **Investigation of Methods for the Production of High Quality, Low Cos. Titanium Alloy Powders**
 Peebles, R. E., Kelto, C. A.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc Symp Powder Metallurgy of Titanium Alloys, 47-58, 1980 (AD-D127 425)
Key Words: Ti-6Al-4V, Ti-17, microstructure, tensile properties, fatigue,

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Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, spraying, particle size

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 Proc Symp Powder Metallurgy of Titanium Alloys, 103-114, 1980 (AD-D127 430)
Key Words: Ti-6Al-4V, porosity, fatigue, crack growth, fractography, tensile properties

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 Mahajan, Y., Eylon, D., Bacon, R., Froes, F. H.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc Symp Powder Metallurgy of Titanium Alloys, 189-202, 1980 (AD-D127 436)
Key Words: Ti-6Al-4V, microstructure, porosity, fracture toughness, fatigue, crack growth, tensile properties, deformation

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 Boyer, R. R., Magnuson, J. E., Tripp, J. W.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc Symp Powder Metallurgy of Titanium Alloys, 203-16, 1980 (AD-D127 437)
Key Words: Ti-6Al-4V, fatigue, crack growth, fracture toughness, microstructure, tensile properties

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 The Metallurgical Society of AIME, Warrendale, PA
 Proc Symp Powder Metallurgy of Titanium Alloys, 229-41, 1980 (AD-D127 439)
Key Words: Ti-6Al-4V, Ti-5Al-2.5Sn, silicon addition, germanium addition, porosity, dispersions

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 The Metallurgical Society of AIME, Warrendale, PA
 Proc Symp Powder Metallurgy of Titanium Alloys, 243-54, 1980 (AD-D127 440)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, aircraft structures, engine components, tensile properties, net shape forming

93. **Hot Isostatic Pressing of Near-Net Titanium Structural Parts**
Witt, R. H., Highberger, W. T.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 255-65, 1980 (AD-D127 441)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, aircraft structures, tensile properties,
net shape forming, fracture toughness

94. **Application of HIP Titanium 6Al-4V Powder to the Radial Compressor for the Cruise Missile Engine**
Barker, C. S., Nagy, P.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 267-77, 1980 (AD-D127 442)
Key Words: Ti-6Al-4V, compressor components, tensile properties, net shape forming, fatigue,

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Chanani, G. R., Highberger, W. T., Kelto, C., Petersen, V. C., Scarich, G. V.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Powder Metallurgy of Titanium Alloys, 279-90, 1980 (AD-D127 443)
Key Words: Ti-6Al-4V, aircraft structures, tensile properties, fracture toughness, net shape forming, fatigue, crack growth, fractography

96. **Advanced Manufacturing Methods for High Quality Low Cost Titanium Powder Production**
Peebles, R. E.
General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Report Feb-May 78
Rept No : AFML-IR-189-7T(3), 44 pp., 1978 (AD-D112 925L)
Key Words: Ti-6Al-4V, turbine components, fabrication, particle size

97. **Built-Up Low-Cost Advanced Titanium Structures (BLATS)**
Pacz, C.
Grumman Aerospace Corp., Bethpage, NY
Third Quarterly Program Report Apr-Jul 78
Contract No : F33615-77-C-3109
61 pp., 1978 (AD-D113 509L)
Key Words: Ti-6Al-4V, Ti-15V-3Cr-3Al-3Sn, diffusion welding, superplastic forming, lap shear strength

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Peebles, R. E.
General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Report, May-Nov 78
Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

99. **Amorphous Glassy Metal and Microcrystalline Alloys for Aerospace Applications**
Collings, E. W., Maringer, R. E., Mobley, C. E.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-70 and GIDEP-E126-1832, 257 pp., 1978 (AD-A060 353)
Key Words: Ti-6Al-4V, microstructure, phase diagram, fabrication, tensile properties

100. **Consolidation of Titanium Powder to Near Net Shapes**
Schwertz, J. H., Chandhok, V. K., Peterson, V. C., Thompson, V. R.
Colt Industries Inc., Crucible Materials Research Center, Pittsburgh, PA
Final Report
Rept No : AFML-TR-78-41, 333 pp., 1978 (AD-A078 039)
Key Words: Ti-6Al-4V, Ti-17, microstructure, fatigue, fracture, stress,
Charpy impact, tensile properties, near net shape

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Dreger, D. R.
Mach Des 50 (17), 20-2, 1978 (AD-D113 100)
Key Words: Ti-6Al-4V, titanium, spacecraft, applications, tensile properties,
density

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Grumman Aerospace Corp., Bethpage, NY
Third Technical Bulletin, Mar.-May 1978
Contract No : F33615-77-C-3109
9 pp., 1978 (AD-D113 232)
Key Words: Ti-6Al-4V, Ti-6Al-2Zn-2Sn-2Mo-2Cr

103. **Built-Up Low-Cost Advanced Titanium Structures (BLATS)**
Grumman Aerospace Corp., Bethpage, NY
Fourth Technical Bulletin, May-July 1978
Contract No : F33615-77-C-3109
9 pp., 1978 (AD-D113 510)
Key Words: Ti-6Al-4V, Ti-6Al-2Zn-2Sn-2Mo-2Cr, welding, superplastic forming

104. **Opportunities for Cost-Affordable Titanium Aerospace Structures**
Tupper, N. G., Elbaum, J. K., Burt, H. M.
J Met 30 (9), 7-13, 1978 (AD-D113 721)
Key Words: Ti-6Al-4V, F-15 aircraft, aircraft structures, superplastic
forming, net shape forming, diffusion bonding

105. **Hot Isostatic Processing**
Hanes, H. D., Seifert, D. A., Watts, C. R.
Metals Information Analysis Center, West Lafayette, IN
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Key Words: Ti-6Al-4V, Ti-15V-3Cr-3Al-3Sn, diffusion welding, superplastic forming, lap shear strength

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Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

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Key Words: Ti-6Al-4V, Ti-17, microstructure, fatigue, fracture, stress, Charpy impact, tensile properties, near net shape

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Key Words: Ti-6Al-4V, Ti-6Al-2Zn-2Sn-2Mo-2Cr

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Key Words: titanium alloys, aluminum alloys, nickel alloys, beryllium, porosity, plasticity, impact strength, tensile properties, fatigue, sintering, cost, preheating

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Marley, W. F., Jr.
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Key Words: Maraging 300, titanium alloys, shock loading, dispersion hardening, thermomechanical treatment

INTERMETALLIC COMPOUNDS

Ni(3)Al

1. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
Stoloff, N. S., Alman, D. E.
Mater Sci Eng A A144, 51-62, 1991
Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties
2. **High Temperature Deformation Behavior of the Ni(3)Al Compacts Produced by Hot Pressing of Mechanically Alloyed Powder**
Esaki, H., Tokizane, M.
Nippon Kinzoku Gakkaishi (J. Jpn. Inst. Met.) 55 (4), 452-8, 1991
Key Words: Ni(3)Al, mechanical alloying, ball milling, compressive properties, strain rate sensitivity, dynamic recrystallization
3. **Modelling of Hipping Consolidation Applied to Ni(3)Al Powders**
Wright, R. N., Williamson, R. L., Knibloe, J. R.
Powder Metall 33 (3), 253-9, 1990
Key Words: Ni(3)Al, Ni-19 at pct Al-8.5 at pct Cr, grain boundary diffusion, creep, tensile properties, atomization
4. **Intermetallic Compounds and Their Powder Metallurgy Materials**
Ni, R., Sun, Yuan
Foreign Technology Division, Wright-Patterson AFB, OH
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Rept No : FTD-ID(RS)T-1058-90, 7 (4), 253-61, 1989 (AD-A237 176)
Key Words: Ni(3)Al, turbine components, corrosion resistance, tensile properties, rapid solidification, grain growth, coatings
5. **Ni(3)Al-Base Alloys Processed by Rapid Solidification**
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Key Words: Ni(3)Al, microscopy, grain size, densification, flow stress, tensile properties
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Key Words: Ni(3)Al, fracture, crack propagation, fatigue, tensile properties
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Kaysser, W. A., Laag, R., Murray, J. C., Petzow, G.
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Key Words: NiAl, gas atomization, sintering, microstructure, density, grain size, tensile properties, fracture path, fracture toughness, hardness, titanium additions niobium additions
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Key Words: NiAl, density, HIP maps, diffusion
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Concannon, M., Hodge, E. S., Nyce, A. C., Turmel, C. P.
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Key Words: NiAl, niobium addition, titanium addition, microstructure, grain size, impurities, fracture surface, intergranular fracture, transgranular fracture, fracture toughness, creep, hardness, elastic modulus, tensile properties, melting point, Poisson's ratio
5. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
Stoloff, N. S., Alman, D. E.
Mater Sci Eng A A144, 51-62, 1991
Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

6. **Powder Processing of High Temperature Aluminides**
German, R.M., Bose, A., Stoloff, N.S.
Materials Research Society, Pittsburgh, PA
Proc Symp High-Temperature Ordered Intermetallic Alloys III
133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4), TaAl(3), microstructure, tensile properties
7. **Microstructures and Mechanical Behavior of Mechanically Alloyed Nickel Aluminide**
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Key Words: NiAl, microstructure, grain refinement, consolidation, mechanical alloying, tensile properties, fracture, creep
8. **High Temperature Intermetallics by Powder Processing**
Bose, A., Moore, B., Stoloff, N.S., German, R.M.
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Key Words: NiAl, IN-100, MAR-M509, RENE' 95, AA 2024-T6, consolidation, REP, tensile properties, impact toughness
10. **P/M Processing of Intermetallic Compounds of CsCl Type for High Temperature Applications**
Vedula, K., Anderson, G., Pathare, V., Aslandis, I.
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Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
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Key Words: FeAl, NiAl, hot extrusion, creep, compressive properties

Ti(3)Al

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
Mater Sci Forum, 88-90, 155-62, 1992
Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling, microstructure, mechanical properties, microhardness
2. **Synthesis of Titanium Aluminide (TiAl) Intermetallic Compounds by HIP-Reaction Sintering**
Kakitsuji, A., Miyamoto, H., Elsevier, London, UK
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Key Words: TiAl, Ti(3)Al, reaction sintering, microstructure, grain size
3. **P/M Processing of Titanium Aluminides**
Moll, J. H. et al., Int J Powder Metall 26 (2), 149-55, 1990
Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

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Key Words: Ti(3)Al, microstructure, porosity, corrosion, oxidation, grain
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Key Words: Ti(3)Al, turbine components, niobium addition, molybdenum
 addition, lanthanum addition, erbium addition, cerium
 addition, rapid solidification, thermomechanical treatment,
 fracture toughness, impact strength, tensile properties, creep
 rupture, fatigue

TiAl

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
 Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
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Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling,
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Key Words: TiAl, Ti(3)Al, reaction sintering, microstructure, grain size

4. **Powder Processing of Intermetallic Alloys and Intermetallic Matrix Composites**
 Stoloff, N. S., Alman, D. E.
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Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive
 sintering, densification, injection molding, reaction milling,
 mechanical alloying, Charpy impact, tensile properties

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Key Words: TiAl, compressive properties, three point bend, self-propagating
 high-temperature synthesis

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Key Words: TiAl, aerospace applications, microstructure, hardness, tensile
 properties, bend test

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Key Words: TiAl, PREP, ball milling compressive properties, microstructure

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Key Words: TiAl, structural parts, airframes, turbine components, extrusion,
 reactive hiping

11. **Mechanical Properties of Sintered TiAl Prepared by Canning Hipping**
 Nakamura, M., Kaieda, Y., Powder Metall 33 (2), 133-9, 1990
Key Words: TiAl, grain size, impurities, crack growth, fracture surface,
 compressive properties, three point bend, bend strength, work hardening

12. **Powder Processing of High Temperature Aluminides**
 German, R.M., Bose, A., Stoloff, N.S.
 Materials Research Society, Pittsburgh, PA
 Proc Symp High-Temperature Ordered Intermetallic Alloys III
 133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4), TaAl(3), microstructure, tensile
 properties

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Key Words: TiAl, microstructure, fracture, tensile properties, REP, bimetal
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Nakamura, M., Kaieda, Y.
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Key Words: TiAl, microstructure, compressive properties, hardness, sintering, atomization, bend properties
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Key Words: TiAl, microstructure, phase diagram, consolidation, REP, rapid solidification
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Yolton, C. F., Lizzi, T., Chandhok, V. K., Moll, J. H.
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Key Words: TiAl, turbine components, creep rupture, tensile properties, plastic deformation
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National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
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Key Words: TiAl, grain size, strengthening, flow stress, compressive properties, hot extrusion
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Shappirio, J. R., Calella, P. C., Eckart, D. W.
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Key Words: TiAl, Ti-6Al-6V-2Sn, dissimilar joining, diffusion bonding

Miscellaneous Intermetallic Compounds

1. **Microstructure and Mechanical Properties of HIPed compacts of Mechanically Alloyed Titanium-Aluminum Powder**
Park, Y. H., Hashimoto, H., Watanabe, R., Ahn, J. H., Chung, H. S.
Mater Sci Forum, 88-90, 155-62, 1992
Key Words: TiAl, Ti(3)Al, Al(3)Ti, mechanical alloying, ball milling, microstructure, mechanical properties, microhardness
2. **HIP Consolidation of Aluminum-Rich Intermetallic Alloys and Their Composites**
Frazier, W. E., Donnellan, M. E.
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Key Words: Al(3)Ti, aircraft structures, tensile properties, crystal structure, copper addition, melting point

3. **Microstructure and Tensile Properties of Fe(3)Al Produced by Combustion Synthesis/Hot Isostatic Pressing**
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Key Words: Fe(3)Al, tensile properties, microstructure, combustion synthesis

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 Contract No : N62269-91-C-0247
 Rept No : BDM/VAS-0746-91-TR, 15 pp., 1991 (AD-B161 960)
Key Words: intermetallic compounds, turbine components, processing, microstructure, densification, near net shape forming, finite element analysis, control systems

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Key Words: Ti-24Al-11Nb, microstructure, PREP, thermomechanical treatment, hydrogenation, phase diagram, superplasticity

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 Zarubitskaya, L. I., Korobka, Yu. V.
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Key Words: TiFe, hydrogen power generation, sintering, electrolytic powder, hydrogen capacity

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 Stoloff, N. S., Alman, D. E.
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Key Words: Al(3)Ta, NiAl, Ni(3)Al, NbAl(3), TiAl, phase diagram, reactive sintering, densification, injection molding, reaction milling, mechanical alloying, Charpy impact, tensile properties

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 Cotton, J. D., Kim, Y. S., Kaufman, M. J.
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Key Words: MoSi(2), hot pressing, arc melting, inclusions, fracture grain growth, carbon addition

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Key Words: Fe(3)Al, density, powder size, sintering temperature

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Key Words: Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-6Al-2Sn-4Zr-1Mo, Ti-48 at pct Al-1 at pct V, microstructure, particle size, tensile properties, stress rupture, plasma spraying

11. **Densification of Rapidly Solidified Titanium Aluminide Powders-II. The Use of a Sensor to Verify Hipping Models**
 Choi, B. W., Marschall, J., Deng, Y. G., McCullough, C., Paden, B., Mehrabian, R.
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Key Words: Ti-48 at pct Al-2.5 at pct Nb, Ti-50 at pct Al-2 at pct Nb,
 atomization, density, densification, rapid solidification, REP

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 Choi, B. W., Deng, Y. G., McCullough, C., Paden, B., Mehrabian, R.
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Key Words: Ti-48 at pct Al-2.5 at pct Nb, Ti-50 at pct Al-2 at pct Nb,
 atomization, particle size, grain size, consolidation, rapid
 solidification, REP, density

13. **Fabrication of the D0(22)-Type Intermetallic Compound Al₃Ta via Powder Metallurgy Processes and its Characterization**
 Pak, H. R., Pak, J. S. L., Rigsbee, J. M., Wayman, C. M.
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Key Words: Al(3)Ti, aluminum, tantalum, crystal structure, lattice
 parameters, phase diagram, density, dislocations, grain
 boundaries, deformation, fabrication

14. **Fabrication of Intermetallic Compounds by Solid State Reaction of Roll-Bonded Materials**
 Fishman, S. G., Martin Marietta Astronautics Group, Denver, CO
 Rept No : MCR-85-721, 6 pp., 1990 (AD-A229 386)
Key Words: Ti(2)Be(17), TiBe(12), microstructure, fracture surface, tensile
 properties, foil, roll bonding, fabrication

15. **Modelling of Hipping Consolidation Applied to Ni(3)Al Powders**
 Wright, R. N., Williamson, R. L., Knibloe, J. R.
 Powder Metall 33 (3), 253-9, 1990
Key Words: Ni(3)Al, Ni-19 at pct Al-8.5 at pct Cr, grain boundary diffusion,
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 Materials Research Society, Pittsburgh, PA
 Proc Symp High-Temperature Ordered Intermetallic Alloys III
 133, 403-14, 1989 (AD-D143 438)
Key Words: NiAl, TiAl, NbAl(3), Ta(2)Al(4), TaAl(3), microstructure, tensile
 properties

17. **High Temperature Intermetallics by Powder Processing**
 Bose, A., Moore, B., Stoloff, N.S., German, R.M.
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Key Words: NiAl, Nb(3)Al, phase diagram, elongation, tensile properties

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Key Words: TiNi, microstructure, microprobe analysis, martensitic
 transformation, density

19. **P/M Processing of Intermetallic Compounds of CsCl Type for High Temperature Applications**
Vedula, K., Anderson, G., Pathare, V., Aslandis, I.
Metal Powder Industries Federation, Princeton, NJ
Proc Int Powder Metallurgy Conf, Modern Developments in Powder Metallurgy
16, 717-44, 1985 (AD-D138 357)
Key Words: FeAl, NiAl, hot extrusion, creep, compressive properties

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Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid
solidification, injection molding

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Clark, J. B., Hopple, G. B., Wright, R. N.
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Key Words: Nb(3)Sn, compressive properties, grain size, creep, plastic
deformation, activation energy

22. **Materials Research for Advanced Inertial Instrumentation. Task 3. Rare Earth Magnetic Material Technology as Related to Gyro Torquers and Motors**
Das, D., Kumar, K.
Charles Stark Draper Lab Inc., Cambridge, MA
Technical Report
Rept No : CSDL-R-1614, TR-5, 73 pp., 1982 (AD-A126 982)
Key Words: SmCo(5), plasma spraying, sintering, arc spraying

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Das, D., Kumar, K., Wettstein, E.
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Rept No : CSDL-R-1529, TR-4, 70 pp., 1981 (AD-A114 955)
Key Words: Sm(5)Co, thermal expansion, x-ray diffraction, plasma deposition

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Bhatt, D. D., Meyer, G. E., Hoffmann, A. L.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-59, 130 pp., 1978 (AD-B031 214)
Key Words: Ti-16Al-10Nb, Ti-12Al-19Nb, Ti-13Al-20Nb, Ti-36Al-5Nb,
Ti-32Al-5Nb-5W, rolling, superplastic forming, joining,
tensile properties, hardness, fatigue, creep test, bend test

REFRACTORY METALS AND ALLOYS

Molybdenum Alloys

1. **Structure and Mechanical Properties of Mo-ZrO₂ Materials Densified by HIP**
Muramatsu, Y., Funami, K., Halada, K., Hoshimoto, K.
J Jpn Inst Met 52 (8), 803-9, 1988 (AD-D139 796)
Key Words: Molybdenum alloys, microstructure, flexural properties, fracture toughness, transformation toughening
2. **Sintering Behavior and Mechanical Properties of Activated Sintered Molybdenum**
Hofmann, H., Grosskopf, M., Hofmann-Amtenbrink, M., Petzow, G.
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Key Words: molybdenum alloys, nickel addition, microstructure, bend properties
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Barranco, J. M., Isserow, S.
Large Caliber Weapon Systems Lab, Army Armament and Development Center, Watervliet, NY
Final Technical Report
Rept No : ARLCB-TR-85017, 42 pp., 1985 (AD-A158 315)
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Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

Niobium and Niobium Alloys

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Jha, S. C., Ray, R.
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Key Words: Nb-10Hf, WC-103, microstructure, grain size, dispersoids, tensile properties
2. **Alternate Processing Concepts for P/M Columbium Alloys**
Friedman, G. I.
TRW Inc., Materials Technology, Cleveland, OH
Rept No : TRW-ER-8249-F, 43 pp., 1983 (AD-B077 405L)
Key Words: C-103, niobium alloys, forging, tensile properties welding, scrap reclamation
3. **Pressing of Powder Materials (Selected Pages)**
Umanskiy, A. M.
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1399-81, 31 pp., 1982 (AD-B062 478L)
Key Words: tungsten alloys, niobium alloys, steels, press forging, density, shrinkage
4. **Creep Behavior of Hot Isostatically Pressed Niobium Alloy Powder Compacts**
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Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys
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Westinghouse Astronuclear Lab, Pittsburgh, PA
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Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

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Key Words: tantalum, microstructure, mechanical properties, electron beam melting, near net shape
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Key Words: Al(3)Ti, aluminum, tantalum, crystal structure, lattice parameters, phase diagram, density, dislocations, grain boundaries, deformation, fabrication
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Key Words: T-111, Ti-6Al-4V, AA A356-T61, IN-738, RENE' 80, Udimet 700, IN-792, welding, tensile properties, pressure bonding
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Arcella, F. G.
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Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys
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Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

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1. **Hot Isostatic Pressing and Sintering Behavior of Yttrium Oxide Dispersed Tungsten**
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Key Words: tungsten, yttrium oxide addition, sintering, density, bend strength

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Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1399-81, 31 pp., 1982 (AD-B062 478L)
Key Words: tungsten alloys, niobium alloys, steels, press forging, density, shrinkage
3. **Processing and Characterization of Several Tungsten Alloys**
Hall, R. C., Ossin, A., Ammon, R. L., Buckman, R. W., Aronin, L.
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Key Words: W-10Cu, W-2ThO₂, W-4Re, W-0.5HfC, turbine components, leading edges, microstructure, tensile properties, thermal properties
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Arcella, F. G.
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Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys
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Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion
6. **Carbide Tools for Cold Extrusion**
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Key Words: tungsten alloys, compressive properties, creep rupture, fatigue, tooling

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 Duva, J. M., Crow, P. D.
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2. **Technology of HIPing Complex Shape Parts With Dual Chemical Composition and Properties from Metal Powders: Trends of Its development in the USSR**
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 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-0342-85, 14 pp., 1985 (AD B097 2701.)
Key Words: mechanical properties, plastic deformation, extrusion, heat treatment

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Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

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 Fraser, H. L.
 Department of Materials Science and Engineering, Illinois University at Urbana
 Annual Technical Report Number Two
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Key Words: Al-8Fe-2Mo, Mg-20Gd, Mg-1Si, Mg-2Si, Mg-3Si, Mg-4Si, Mg-5Si, Mg-8Si, Mg-5Li, Mg-12Li, Mg-5Li-5Si, Mg-8Li-5Si, Mg-12Li-5Si, aerospace applications, rapid solidification, melt spinning, tensile properties, precipitation, solution heat treatment

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Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

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Key Words: beryllium, copper, mirror, coatings, temperature effect

8. **An Evaluation of Real and Programmed Defect Conditions in HIP Discs Using Holosonics' System 200 Scanned Acoustical Holography Imaging System**
Knuter, N. J.
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Final Report
Rept No : USAAVSCOM-TR-76-25, 140 pp., 1976 (AD-A038 264)
Key Words: holography, acoustic emission, defects, nondestructive testing

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Wilcox, B. A., Veigel, N. D., Clauer, A. H.
Metall Trans 3 (1), 273-83, 1972 (AD-D123 239)
Key Words: chromium, Cr-ThO₂, tensile properties, microstructure, annealing

2. Castings

ALUMINUM ALLOYS

AA A201

1. **Effect of Hot Isostatic Pressure on Cast Aluminum Airframe Components**
Mocarski, S. J., Scarich, G. V., Wu, K. C.
Trans Am Foundrymen's Soc 99, 77-81, 1991
Key Words: AA A201-T7, aircraft structures, fatigue, tensile properties, fracture toughness
2. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
Bouse, G. K., Behrendt, M. R.
Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties.
3, 1665-80, 1986 (AD-D140 112)
Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness
3. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R., Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue
4. **Hot Isostatic Pressing of Aluminum Alloy Castings**
Vonk, S. J., Hoppin, G. S., Benn, K. W.
Garrett Turbine Engine Co., Phoenix, AZ
Rept No : 31-3968, 54 pp., 1981 (AD-A105 562)
Key Words: AA A201, porosity, microstructure, tensile properties, fatigue
5. **Advanced Aluminum Metallic Materials and Processes for Application to Naval Aircraft Structures**
Highberger, W. T., Scarich, G. V., Chanani, G. R.
SAMPE, Azusa, CA
Proc 12th National SAMPE Technical Conf 554-62, 1980 (AD-D127 131)
Key Words: AA A201-T7, porosity, tensile properties, fatigue, crack growth rate

AA A356

1. **A Statistical Model for Predicting the Fracture of Silicon Particles in HIPed A356 Aluminum Castings**
Chou, J. S., Meyers, C. W.
Trans Am Foundrymen's Soc 99, 165-, 1991
Key Words: AA A356, microcracking, porosity, plastic deformation
2. **Experimental Investigations of deformation in HIPped A356 aluminum castings**
Meyers, C. W., Chou, J. S.
Trans Am Foundrymen's Soc 99, 175-86, 1991
Key Words: AA A356, casting, microstructure, fracture fracture toughness, tensile behavior, deformation

3. **Developing Aluminum-Lithium Alloys for Investment Casting**
Haynes, T. G., III, Tesar, A. M., Webster, D.
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Key Words: AA A356-T6, microstructure, fracture, tensile properties
4. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4
5. **Improving Casting Properties and Integrity with Hot Isostatic Pressing**
Rooy, E. L.
Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties
6. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R., Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue
7. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E. Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61 142-T6, net shape forming, fatigue, tensile properties
8. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue
9. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

AA A357

1. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
Bouse, G. K., Behrendt, M. R.
Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties.
3, 1665-80, 1986 (AD-D140 112)
Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness

2. **Correction of Casting Faults by the Hot Isostatic Pressing of High Strength Aluminum Materials**
Zeitler, H., Scharfenberger, W.
Aluminum English 60 (12), E803-8, 1984 (AD-D131 723)
Key Words: AA A357-T6, fracture defects, porosity, sand casting

3. **Improving Casting Properties and Integrity with Hot Isostatic Pressing**
Rooy, E. L.
Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties

4. **Development and Demonstration of Economic Production Systems in Airframe Construction. Part 2: Technological Phase. Part 6: Review**
NTIS, N84-23555, Springfield, VA
Final Report, Dec 80-Jun 83
Rept No : N84-23555, 152 pp., 1983 (AD-D134 719)
Key Words: AA A357, titanium alloys, fracture mechanics, diffusion bonding, fatigue

5. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

6. **High Integrity Casting Program**
Schweikert, W. H.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

Miscellaneous Aluminum Alloys

1. **Effect of Heat Treatment and Hot Isostatic Pressing on Void Density and Fracture Mode of Al(67)Ni(8)Ti(25)**
Mysko, D.D., Lumsden, J.B., Powers, W.O., Wert, J.A.
Scr Metall 23(11), 1827-30, 1989 (AD-D143 812)
Key Words: Al-8Ni-25Ti, electrode arc melting, microstructure, heat treatment, transgranular fracture, voids

2. **The Mechanical Properties of Superplastically Formed Titanium and Aluminum Alloys**
Partridge, P. G., McDermid, D. S., Bottomley, I., Common, D.
Royal Aircraft Establishment Farnborough, UK
AGARD Lecture Series, Superplasticity AGARD-LS-154
6-1 to 6-23, 1987 (AD-D139 987)
Key Words: Ti-6Al-4V, AA 7475, Supral 100, Supral 150, Supral 220, alclad coatings, microstructure, grain size, aging, elastic properties, fatigue, fracture toughness

3. **Hot Isostatic Pressing of Aluminum-Silicon Castings**
 Chama, C. C.
 Pennsylvania State University, Dept. of Materials Science and Engineering,
 University Park, PA
 Dissertation
 275 pp., 1986 (AD-D139 361)
Key Words: Al-7Si, Al-10Si, porosity, tensile properties

4. **Fracture Toughness and Fatigue Crack Growth Rate Testing of Premium Quality Vacuum Investment Cast 200 and 300 Series Aluminum Alloys**
 Bouse, G. K., Behrendt, M. R.
 Proc Int Conf Aluminum Alloys--Their Physical and Mechanical Properties.
 3, 1665-80, 1986 (AD-D140 112)
Key Words: AA A201-T7, AA A206-T71, AA A357-T6, turbine components, airframes, crack growth rate, fracture toughness

5. **Hot Isostatic Press**
 Author Anon
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

6. **Manufacturing Technology for Cast Aluminum Alloy Compressor Housings**
 Johnson, C. A.
 Naval Weapons Center, China Lake, CA
 Final Report Mar 81-May 84
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Key Words: AA 6061-T6, 15-5PH, tensile properties, fracture, metallography, bend test, burst test

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 Rooy, E. L.
 Modern Casting 73(12), 18-20, 1983 (AD-D128 854)
Key Words: AA A356-T61, AA A357-T62, F132-T6, porosity, fatigue, tensile properties

8. **Application of the HIP Process to Aluminum and its Alloys**
 Hofer, B.
 Aluminum English 59 (12), E536-8, 1983 (AD-D129 047)
Key Words: Al-10Si, Al-4Cu, Al-7Si, diffusion, bonding, porosity, net shape forming, mechanical properties

9. **Treatment Processes of Light and Heat Resistant Alloys**
 Belov, A. F., Tselikov, A. I., Trishkin, V. G., Rakovskiy, V. S., Rykalin, N. N.
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-0412-82, 335 pp., 1982 (AD-B070 680L)
Key Words: aluminum alloys, titanium alloys, mechanical properties, fatigue, cracking

10. **Porous Castings? HIPping Might be Your Answer**
 Widmer, R., Price, P. E.
 Modern Casting 72 (8), 42-3, 1982 (AD-D125 344)
Key Words: Ti-6Al-4V, stainless steel, aluminum alloys, porosity, rejuvenation, cost

11. **Hipping is One Way to Check Porosity in Cast Components**
 Irving, R. R.
 Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

12. **The Development of Aluminum-Lithium Alloys**
 Gayle, Frank W.
 Reynolds Metals Co., Metallurgical Research Division, Richmond, VA
 Final Report
 Contract No : N00019-78-C-0485
 178 pp., 1980 (AD-A090 138)
Key Words: Al-(2-3)Li, scandium addition, gallium addition, manganese addition, magnesium addition, silver addition, copper addition, iron addition, dispersion hardening, microstructure, hardness, tensile properties

13. **Trends in Casting Technology**
 Chandler, H. E., Baxter, D. F.
 Metal Prog 117 (1), 97-9, 1980 (AD-D117 224)
Key Words: AA 6061-T6, AISI 4340, Fe-3C-19Cr-1.5Ni-2Mo, tensile properties

14. **Cutting Metal Loss Tied to Near Net Shapes**
 Harvey, R. E.
 Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

15. **Casting High-Performance, High-Integrity Components**
 Heine, H. J.
 Foundry Manage Technol 105 (3), 88-96, 1977 (AD-D108 804)
Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, 31964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, triballoy

16. **Improved Properties in Castings by Hot Isostatic Pressing**
 Glenn, G. M.
 SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355, porosity, tensile properties, microstructure, creep rupture, density, fatigue

BERYLLIUM AND BERYLLIUM ALLOYS

1. **Characteristics of Mechanically Fastened Joints of CIP/HIP-1 Beryllium**
Chou, S-C., Rainey, J. H., Swanson, R. A.
Army Materials and Mechanics Research Center, Watertown, MA
Final Report
Rept No : AMMRC-TR-79-48, 37 pp., 1979 (AD-A078 275)
Key Words: beryllium, bearing strength, stress-strain, stress analysis
2. **Materials Research for Advanced Inertial Instrumentation. Task 2. Gas Bearing Material Development by Surface Modification of Beryllium**
Das, D., Kumar, K., Wettstein, E., Wollam, J.
Charles Stark Draper Lab Inc., Cambridge, MA
Technical Report Number Two
Rept No : R-1330, 70 pp., 1979 (AD-A084 780)
Key Words: beryllium alloys, ion implantation, boride coatings, plasma deposition
3. **Containerless Processing of Beryllium Experiment 74-48**
Wouch, G., Keith, G. H., Frost, R. T., Pinto, N.P.
General Electric Co., Space Div., Philadelphia, PA
Final Report
Rept No : N77-27211, 65 pp., 1977 (AD-D111 224)
Key Words: beryllium, beryllium oxide addition, grain structure, space processing, zero gravity environment, thermal analysis
4. **Creep Mechanisms in Beryllium**
Webster, D., Crooks, D. D.
Metall Trans 7A (9), 1307-15, 1976 (AD-D107 626)
Key Words: beryllium, RR243, BSP9, T30, 9776, 9713, 8084, EF1, creep properties, cracking, grain boundaries, plastic deformation

COBALT ALLOYS

MAR-M509

1. **Fatigue Dominated Damage Processes**
Bressers, J., Remy, L., Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
441-68, 1986 (AD-D142 075)
Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286,
Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue
2. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422,
Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine
components, fan blades, compressor components, coatings,
unidirectional solidification, superplastic forming
3. **Quality of Castings of Superalloys**
Bachelet, E., Lesoult, G.
Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001,
B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC,
creep properties, fatigue, crack growth, thermal fatigue,
porosity
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Bisset, J. W.
United Technologies Corp., East Hartford, CT
Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine
components, single crystals, hafnium addition, unidirectional solidification, cost
5. **Study of Superalloys Produced via Powder Metallurgy**
Heilner, L., Johansson, H., NTIS, N77-13210, Springfield, VA
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking,
microstructure, temperature effect, deformation, stress
intensity, tensile properties
6. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.,
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile
properties, fatigue, hardness, creep rupture, fracture toughness

X-40

1. **Microstructural Damages Induced During the Repair Process**
Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part I
811-20, 1986 (AD-D142 085)
Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding
2. **Repair and Rejuvenation Procedures for Aero-Gas-Turbine Hot-Section Components**
Bell, S. R.
Mater Sci Technol 1 (8), 629-34, 1985 (AD-D133 818)
Key Words: Nimonic 108, RENE' 100, Nimocast PD21, X-40, C1023, turbine components, repair welding, microstructure, rejuvenation, creep
3. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming
4. **Quality of Castings of Superalloys**
Bachelet, E., Lesoult, G.
Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity
5. **Study of Superalloys Produced via Powder Metallurgy**
Hellner, L., Johansson, H.
NTiS, N77-13210, Springfield, VA
Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

Miscellaneous Cobalt Alloys

1. **Microstructural Damages Induced During the Repair Process**
Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part I
811-20, 1986 (AD-D142 085)
Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding

2. **Long Term Materials Test Program: Materials Evaluation--Improved Simulation Tests**
 Brobst, R. P., McCarron, R. L., Beltran, A. M., Spriggs, D. R., Grzybowski, D. F.
 General Electric Co., Energy Systems Programs Department, Schenectady, NY
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 Rept No : DE82-000649, 54 pp., 1981 (AD-D125 182)
Key Words: FSX-414, IN-738, GTD-111, turbine components, coatings, erosion,
 hot corrosion

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 Kear, B. H., Thompson, E. R.
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Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422,
 Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine
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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001,
 B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC,
 creep properties, fatigue, crack growth, thermal fatigue,
 porosity

5. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
 Mishka, K. H.
 Mater Eng 84 (3), 22-4, 1976 (AD-D104 639)
Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077, MA754E,
 MA757E, turbine components, zirconium coatings, tensile
 properties, creep rupture, thermal processing, thermal
 fatigue, oxidation, gamma prime, oxide dispersion
 strengthening

6. **Effect of Autoclave Heat Treatments on the Mechanical Properties of the Prealloyed Powder Cobalt-Base Alloy HS-31**
 Freche, J. C., Ashbrook, R. L.
 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
 Technical Note
 Rept No : NASA-TN-D-7117, 22 pp., 1973 (AD-181 092)
Key Words: HS-31, microstructure, heat treatment, creep rupture, tensile
 properties

IRON ALLOYS

17-4PH

1. **Influence of Processing Route on Fatigue Behavior of Investment Cast High Strength Steels**
McCallum, R., Lang, W.
NTIS, PB85-234813, Springfield, VA
Technical Report
Rept No : NEL-697, 35 pp., 1985 (AD-D135 646)
Key Words: 17-4PH, EN40B, microstructure, fatigue, cracking
2. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity
3. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost
4. **High Integrity Casting Program**
Schweikert, W. H.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 392-405, 1976 (AD-D119 186L)
Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing
5. **Precision Castings State-of-the-Art**
Nagan, R. M.
SAMPE Qtrly 6 (4), 1-7, 1975 (AD-D102 565)
Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

AISI 4340

1. **Trends in Casting Technology**
Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 97-9, 1980 (AD-D117 224)
Key Words: AA 6061-T6, AISI 4340, Fe-3C-19Cr-1.5Ni-2Mo, tensile properties
2. **Rare Earth Modified High Strength Steels via P/M Processing**
Sheinker, A. A.
TRW Inc., Materials Technology, Cleveland, OH
Technical Report
Rept No : TRW-ER-8097, 66 pp., 1979 (AD-A080 637)
Key Words: AISI 4340, metallography, fractography, tensile properties, Charpy impact

3. **Complex Rotor Fabrication by Hot Isostatic Pressure Welding**
 Lessman, G. G., Bryant, W. A.
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Key Words: AISI 4340, Inconel 718, hardness, tensile properties
4. **Investigation of Solidification of High Strength Steel**
 Gnanamuthu, D. S., Basaran, M., Kattamis, T. Z., Mehrabian, R., Flemings, M. C.
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 Technical Rept., Jan Dec 1971
 Rept No : AMMRC-CTR-72-6/1, 82 pp., 1972 (AD-753 958)
Key Words: AISI 4340, thermomechanics, porosity, heat treatment

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 Luton, M. J.
 Pergamon Press, Elmsford, NY
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 ICSMA 7-V-2, 859-64, 1987 (AD-D139 302)
Key Words: MA956, grain boundaries, oxide dispersion, strengthening, tensile properties
2. **Materials for Advanced Turbine Engine--MATE**
 Evans, D. J., Sheffler, K. D., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, East Hartford, CT
 Mar-May 82
 Contract No : NAS 3-20072
 1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening
3. **Materials for Advanced Turbine Engine-MATE**
 Evans, D. J., Henricks, R. J., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
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 Contract No : NAS 3-20072
 48 pp., 1981 (AD-D120 953)
Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue
4. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
 Mishka, K. H.
 Mater Eng 84 (3), 22-4, 1976 (AD-D104 639)
Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077 MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening

Miscellaneous Stainless Steels

1. **Manufacturing Technology of 15-5PH Castings for Compressor Housings**
Froehner, T. A., Weed, S. J.
Naval Weapons Center, China Lake, CA
Final Report Mar 81-May 84
Rept No : NWC-TP-6604, 21 pp., 1986 (AD-B101 788L)
Key Words: 15-5PH, hardening, investment casting
2. **Creep Dominated Damage Processes**
Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
413-39, 1986 (AD-D142 074)
Key Words: Incoloy 800H, IN-738LC, IN-939, microstructure, creep, corrosive environment
3. **Fatigue Dominated Damage Processes**
Bressers, J., Remy, L., Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
441-68, 1986 (AD-D142 075)
Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue
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Johnson, C. A.
Naval Weapons Center, China Lake, CA
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Rept No : NWC-TP-6603, 40 pp., 1985 (AD-B101 621L)
Key Words: AA 6061-T6, 15-5PH, tensile properties, fracture, metallography, bend test, burst test
5. **Hot Isostatic Pressing of Stainless Steel--A New Technique for the Offshore Industry**
Andersson, T.
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Key Words: 20Cr-18Ni, 20Cr-25Ni, 22Cr stainless, 26Cr stainless, welding, microstructure, microsegregation, tensile properties
6. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding
7. **Integrally Cast Low-Cost Compressor**
Hessler, Barton H., Muntner, M. S., Cargo, Don, Roopchand, B.
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Rept No : TACOM-TR-12673, 134 pp., 1983 (AD A127 663)
Key Words: Custom 450, turbine components, fatigue, corrosion-fatigue, tensile properties

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Coffin, L. F.
Plenum Press, New York, NY
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Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76,
IN-100, NASA IIB-7, crack growth, fatigue

9. **Ultrasonic Inspectability Improvements in Austenitic Stainless Steel Welds After Thermal-Mechanical Processing**
Lott, L.A., Malik, R.K.
Mater Eval 41 (6), 738-42, 1983 (AD-D315 514)
Key Words: AISI 304, AISI 308, welds, microstructure, ultrasonic properties

10. **Porous Castings? HIPping Might be Your Answer**
Widmer, R., Price, P. E.
Modern Casting 72 (8), 42-3, 1982 (AD-D125 344)
Key Words: Ti-6Al-4V, stainless steel, aluminum alloys, porosity,
rejuvenation, cost

11. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE'
77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

12. **The Joining of Refractory Metals by Hot Isostatic Pressing**
Werdecker, W., Aldinger, F.
High Temp-High Pressures 14 (2), 183-97, 1982 (AD-D127 724)
Key Words: Inconel 601, Kanthal A-1, molybdenum, stainless steel, dissimilar
joining, diffusion bonding, microhardness

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Chandler, H. E., Baxter, D. F.
Metal Prog 117 (1), 97-9, 1980 (AD-D117 224)
Key Words: AA 6061-T6, AISI 4340, Fe-3C-19Cr-1.5Ni-2Mo, tensile properties

14. **All Systems Are Go for Powder Metallurgy**
Irving, R. R.
Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI
329, 12Cr steel, injection molding, cost, applications

15. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
Final Report
Contract No : N00014-78-M-0074
58 pp., 1978 (AD-A061 867)
Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack
detection

16. **Casting High-Performance, High-Integrity Components**
Heine, H. J.
Foundry Manage Technol 105 (3), 88-96, 1977 (AD-D108 804)
Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, B1964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, tribaloy
17. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
Jaffee, R. I.
Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics
18. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
Mishka, K. H.
Mater Eng 84 (3), 22-4, 1976 (AD-D104 639)
Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077 MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening
19. **Manufacturing Methods for the Production of Disc Shapes by Contour Rolling**
Arnold, D. B.
General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Progress Report Number Five, Apr-Jun 72
Rept No : AFML-IR-204-1(V), 22 pp., 1972 (AD-179 851L)
Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

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1. **The Development of the Composite Rolls for Hot Rolling Mills**
Rhee, B. O., Cao, M. Y., Zhang, H. R., Streicher, E., Chung, C. I.
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Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 253-8, 1992
Key Words: high speed steel, toughness, hardness, microstructure, diffusion bonding
2. **Influence of Processing Route on Fatigue Behavior of Investment Cast High Strength Steels**
McCallum, R., Lang, W.
NTIS, PB85-234813, Springfield, VA
Technical Report
Rept No : NEL-697, 35 pp., 1985 (AD-D135 646)
Key Words: 17-4PH, EN40B, microstructure, fatigue, cracking
3. **Emerging Trends in Aerospace Materials and Processes**
Chandler, H. E.
Metal Prog 125 (5), 21-9, 1984 (AD-D130 023)
Key Words: Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, steel, aircraft, net shape forming, manufacturing

4. **Progress of Powder Metallurgy in North America**
 Roll, K.H., Johnson, P.K.
 Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

5. **Hipping is One Way to Check Porosity in Cast Components**
 Irving, R. R.
 Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

6. **All Systems Are Go for Powder Metallurgy**
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7. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
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 State University of New York at Stony Brook, Department of Materials Sciences, NY
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Key Words: Ti 6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

8. **Comparative Evaluation of Forged Ti-6Al-4V Bar made from Shot Produced by the REP and CSC Processes**
 Vaughan, R. F., Blenkinsop, P. A., Morton, P. H.
 Imperial Metal Industries (Kynoch) Ltd., Birmingham, UK MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
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Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fracture surface, titanium, CM steels, superalloys, surface layers, morphology, composition surface

9. **Processing: The Rediscovered Dimension in High Temperature Alloys**
 Semchyshen, M.
 Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

10. **The Effect of Homogenization Treatment and Hot Isostatic Pressing on Microporosity in Cast Steel**
 Basaran, M., Kattamis, T. Z., Mehrabian, R.
 Metall Trans 4 (10), 2429-34, 1973 (AD-D104 149)
Key Words: AISI 4330, porosity, grain boundaries, diffusion homogenizing, spheroidizing

11. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
Argon, A. S.
Massachusetts Institute of Technology, Center for Materials Science and Engineering,
Cambridge, MA
Semi-Annual Technical Report Number Three Jul-Dec 1971
Contract No : DAHC15-70-C-0283
130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile
properties, fatigue, hardness, creep rupture, fracture toughness

Miscellaneous Iron Alloys

1. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid
solidification, injection molding
2. **New Superalloys, Better Processing Promise More Durable Turbine Parts**
Mishka, K. H.
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Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077, MA754E,
MA757E, turbine components, zirconium coatings, tensile
properties, creep rupture, thermal processing, thermal
fatigue, oxidation, gamma prime, oxide dispersion
strengthening

NICKEL ALLOYS

Alloy 713

1. **Microstructure, Creep Properties, and Rejuvenation of Service-Exposed Alloy 713C Turbine Blades**
Maccagno, T. M., Koul, A. K., Immarigeon, J. P., Cutler, L., Allem, R.
L'Esperance, G.
Metall Trans A 21A, 3115-25, 1990 (AD-D144 207)
Key Words: Alloy 713C, turbine components, porosity, microstructure, grain boundaries, creep, rejuvenation
2. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
Quested, P. N., Osgerby, S.
Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep
3. **Development of a Conventional Fine Grain Casting Process**
Woulds, M., Benson, H.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 3-12, 1984 (AD-D132 821)
Key Words: Alloy 713LC, MAR-M247, turbine components, microstructure, creep rupture, tensile properties, fatigue
4. **Optimization of the High Temperature, Low Cycle Fatigue Strength of Precision-Cast Turbine Wheels**
Lamberigts, M., Ballarati, G., Drapier, J. M.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 13-22, 1984 (AD-D132 822)
Key Words: Alloy 713, microstructure, porosity, fatigue
5. **The Effects of Tantalum for Columbium Substitutions in Alloy 713C**
Brinegar, J. R., Mihalisin, J. R., VanderSluis, J.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 53-62, 1984 (AD-D132 826)
Key Words: Alloy 713C, niobium addition, tantalum addition, aging, creep rupture, tensile properties
6. **Improvement of Material Properties of Ni-Base Alloy Investment Castings by Hot Isostatic Processing**
Tsuji, I., Kawai, H.
NTIS, PB84-113422, Springfield, VA
Technical Report
Rept No : MTB-159, 8 pp., 1983 (AD-D130 515)
Key Words: IN-738, IN-738LC, Udimet 500, Alloy 713C, turbine components, fatigue
7. **Blade Life Extended by Pressing Processes**
Radivich, J. F.
American Metal Market 90 (216), 10A & 15A, 1982 (AD-D126 104)
Key Words: Alloy 713C, turbine components, service life, creep rupture rejuvenation

8. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M., Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification
9. **The Metallurgical Aspects of Hot Isostatically Pressed Superalloy Castings**
Antony, K. C., Radavich, J. F.
Proc 4th Int Symp Superalloys, Superalloys 1980 257-65, 1980 (AD-D120 655)
Key Words: Alloy 713C, MAR-M246, microstructure, porosity, tensile properties, creep rupture, fatigue, fracture toughness
10. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure
11. **Quality of Castings of Superalloys**
Bachelet, E., Lesoult, G., Applied Sciences Publishers Ltd., London, UK
High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)
Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity
12. **Premium Quality Castings**
Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue
13. **Materials and Process Technol for Advanced Gas Turbines**
Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture
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Key Words: Alloy 713C, IN-100, Udimet 700, sulfur addition, carbide phases, crack growth

B-1900

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Author Anon, Foreign Technol Div, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

2. **Effect of HIP on Elevated-Temperature Low Cycle Fatigue Properties of an Equiaxed Cast Superalloy**
Anton, D. L., Favrow, L. H., ASTM, Philadelphia, PA
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Key Words: B-1900, microstructure, grain growth, fractography, tensile properties, fatigue

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Van Der Vet, W. J.
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Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

4. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

5. **HIP'ing Raises Casting Performance Levels**
Freeman, W. R., Jr.
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Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

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Freeman Jr., W. R.
Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
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Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

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Bressers, J., Remy, L., Hoffelner, W.
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Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

2. **Materials for Advanced Turbine Engine--MATE**
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Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

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Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422 Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

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Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

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Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

IN-100

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation
2. **Deformation Mechanisms of Thermostructural Materials**
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Key Words: IN-100, RENE' 80, turbine components, CoCrAl coatings, creep rupture, thermal fatigue, barrier coatings, dislocation
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Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture
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Bell, S. R.
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Key Words: Nimonic 108, RENE' 100, Nimocast PD21, X-40, C1023, turbine components, repair welding, microstructure, rejuvenation, creep
5. **Structure-Property Characterization of Rheocast and VADER Processed IN 100 Superalloy**
Cheng, J-J. A., Apelian, D.
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Key Words: IN-100, turbine components, microstructure, fatigue crack growth, rheocasting, tensile properties
6. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A.
Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture
7. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
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Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

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Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue, creep-fatigue, crack growth, porosity, fracture mechanics, tensile properties, microstructure,

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Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

10. **HIP Processing--Potentials and Applications**
 Van Der Vet, W. J.
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Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

11. **Repair and Regeneration of Turbine Blades, Vanes, and Discs**
 Huff, H., Wortmann, J.
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Key Words: IN-100, Nimonic 90, Nimonic 108, turbine components, welding, creep, rejuvenation

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 VerSnyder, F. L.
 Kluwer Boston Inc., Hingham, MA
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Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition, zirconium addition, cobalt addition, turbine components, corrosion, oxidation, REP, creep rupture, thermal fatigue

13. **Precision Casting of Turbine Blades and Vanes**
 Drapier, J. M.
 Kluwer Boston Inc., Hingham, MA
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Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

14. **Creep-Fatigue Environment Interactions in Superalloys**
 Pelloux, R. M.
 Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA
 Final Report
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Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

15. **Energy Efficient Engine. Volume 2. Appendix A: Component Development and Integration Program**
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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

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18. **An Assessment of Hot Isostatic Pressing and Reheat Treatment for the Regeneration of Creep Properties of Superalloys**
 Dennison, J. P., Elliot, I. C., Wilshire, B.
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Key Words: Nimonic 105, IN-100, fracture mechanics, creep, heat treatment

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 Kear, B. H., Thompson, E. R.
 Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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 Stewart, D. C., Bennett, G. T.
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Key Words: IN-100, MAR-M200, unidirectional solidification, creep properties, aluminides, PWA 73 coating, surface defects, rejuvenation

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Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E, WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile properties, coatings, corrosion, thermal fatigue, unidirectional solidification

22. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
 Billard, D., Trottier, J. P.
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Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

24. **HIP'ing Raises Casting Performance Levels**
 Freeman, W. R., Jr.
 Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

25. **Premium Quality Castings**
 Freeman Jr., W. R.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

26. **Cost/Benefit Analysis of Advanced Materials Technologies for Future Aircraft Turbine Engines**
 Bisset, J. W.
 United Technologies Corp., East Hartford, CT
 Project Completion Report
 Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine components, single crystals, hafnium addition, unidirectional solidification, cost

27. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A.
 SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

28. **The Nature of the Sulfo-Carbides Observed in Nickel-Base Superalloys**
 Wallace, W., Holt, R. T., Terada, T.
 Metall 6 (6), 511-26, 1973 (AD-D106 657)
Key Words: Alloy 713C, IN-100, Udimet 700, sulfur addition, carbide phases, crack growth

29. **Structure and Property Control Through Rapid Quenching of Liquid Metals**
 Grant, N. J., Pelloux, R. M., Regis, M. N., Flemings, M. C., Merton, C.
 Argon, A. S.
 Massachusetts Institute of Technology, Center for Materials Science and Engineering, Cambridge, MA
 Semi-Annual Technical Report Number Three Jul-Dec 1971
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 130 pp., 1972 (AD-739 340)
Key Words: IN-100, MAR-M509, Maraging 300, microstructure, tensile properties, fatigue, hardness, creep rupture, fracture toughness

IN-738

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation
2. **Assessment of Service Induced Microstructural Damage and Its Rejuvenation in Turbine Blades**
Koul, A. K., Castillo, R.
Metall Trans 19a (8), 2049-66, 1988 (AD-D139 440)
Key Words: IN-738LC, turbine components, microstructure, grain boundaries, fractography, degradation, service life, rejuvenation, creep properties
3. **Rejuvenation of Service-Exposed IN 738 Turbine Blades**
Koul, A.K., Immarigeon, J-P, Castillo, R., Lowden, P., Liburdi, J.
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Key Words: IN-738, turbine components, rejuvenation, service life, aluminide coatings, creep rupture
4. **The Effect of Service Exposure on the Creep Properties of Cast IN-738LC Subjected to Low Stress High Temperature Creep Conditions**
Castillo, R., Koul, A.K., Immarigeon, J-P.A.
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Key Words: IN-738LC, turbine components, grain boundaries, fracture, creep rupture, stress cracking
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Quested, P. N., Osgerby, S.
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Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep
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Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
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Key Words: Incoloy 800H, IN-738LC, IN-939, microstructure, creep, corrosive environment
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Bressers, J., Remy, L., Hoffelner, W.
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Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

8. **Effect of Fabrication and Repair Procedures on the Performance of IN 738 LC and IN 939**
 Esser, W., McLean, M., Schneider, K.
 Kluwer Academic Publishers, Norwell, MA
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 593-622, 1986 (AD-D142 076)
Key Words: IN-738LC, IN-939, turbine components, welding, gas tungsten arc
 welding, electron beam welding, creep rupture strength, hot
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Key Words: Nimonic 105, IN-738LC, fatigue strain, creep

10. **Hot Isostatic Press**
 Author Anon, Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA
 A356, 142-T4

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 Schneider, K., Jahnke, B., Burgel, R., Ellner, J.
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Key Words: IN-738LC, turbine components, repairs, brazing, welding,
 microstructure, microcracking, oxidation, silicide coatings, fatigue, creep rupture

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Key Words: IN-738LC, Nimonic 80A, Udimet 520, turbine components, repair
 technique, corrosion, erosion, fatigue, tensile properties, tungsten arc welding

13. **Creep Life Predictions in Nickel-based Superalloys**
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Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components,
 deformation, grain size, long term tests, shear stress

14. **Effects of Trace Elements on Mechanical Properties of Superalloys**
 McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain
 boundaries, porosity, creep rupture

15. **Problems and Possibilities for Life Extension in Gas Turbine Components**
 Koul, A. K., Wallace, W., Thamburaj, R.
 National Aeronautical Establishment, Structures and Materials Section
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 Durability by Analysis and Testing, Lisse, Netherlands
 10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine
 components, damage tolerance, EDM, creep, machining

16. **The Influence of Materials Processing on the High Temperature Low Cycle Fatigue Properties of the Cast Alloy IN-738LC**
 Burke, M. A., Beck, C. G., Jr., Crombie, E. A.
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Key Words: IN-738LC, microstructure, crack propagation, fatigue, unidirectional solidification

17. **Assessment of Damage Accumulation and Property Regeneration by Hot Isostatic Pressing and Heat Treatment of Laboratory-Tested and Service Exposed IN738LC**
 McLean, M., Tipler, H. R.
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Key Words: IN-738LC, turbine components, microstructure, stress intensity

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 McLean, M., Peck, M. S.
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Key Words: IN-738LC, turbine components, crystallography, creep, heat treatment, rupture

19. **Improvement of Material Properties of Ni-Base Alloy Investment Castings by Hot Isostatic Processing**
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 NTIS, PB84-113422, Springfield, VA
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Key Words: IN-738, IN-738LC, Udimet 500, Alloy 713C, turbine components, fatigue

20. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
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 Westinghouse Canada Ltd., Hamilton, Ontario, Canada
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Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700, turbine components, microstructure, rejuvenation, creep

21. **HIP Processing--Potentials and Applications**
 Van Der Vet, W. J.
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Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738, IN-782, turbine components, fatigue, thermal cycling, creep rupture

22. **Regeneration of the Creep Properties of a Cast Ni-Cr-Base Alloy**
 Tipler, H. R.
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Key Words: IN-738LC, creep, tensile properties, rejuvenation

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 Jahnke, B.
 Weld J 61 (11), 343s to 347s, 1982 (AD-D125 951)
Key Words: IN-738LC, turbine components, microstructure, hot cracking,
 tensile properties, fatigue

24. **Hipping is One Way to Check Porosity in Cast Components**
 Irving, R. R.
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Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE'
 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

25. **Scope for Repair Welding Gas Turbine Blades**
 Elsner, W.
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Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components,
 microstructure, tensile properties, welding

26. **Development of Hybrid Gas Turbine Bucket Technology**
 Peterson, L. G., Prencetin, D. E., Schilling, W. F., Ostergren, W. J.
 General Electric Co., Gas Turbine Division, Schenectady, NY
 Technical Paper
 Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125,
 RENE' 120, GTD-111, IN-738, turbine components, tensile
 properties, unidirectional solidification, dissimilar joining,
 diffusion bonding, creep rupture

27. **High Cycle Fatigue Properties of Cast Nickel Base Superalloys IN 738LC and IN 939**
 Schneider, K., Gnirs, G., McColvin, G.
 Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 319-44, 1982 (AD-D133 996)
Key Words: IN-738C, IN-939, grain size, porosity, particle size, fatigue

28. **Mechanisms of High Cycle Fatigue of Cast Nickel Base Alloys**
 Schneider, K., Gnirs, G., Truck, B., Arnim, G. V.
 Kluwer Boston Inc., Hingham, MA
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Key Words: IN-738LC, IN-939, grain refinement, crack initiation, fatigue
 life

29. **Hipping: A Good Way to Improve Properties**
 Irving, R. R.
 Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MEPL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine
 components, porosity

30. **Long Term Materials Test Program: Materials Evaluation--Improved Simulation Tests**
 Brobst, R. P., McCarron, R. L., Beltran, A. M., Spriggs, D. R., Grzybowski, D. F.
 General Electric Co., Energy Systems Programs Department, Schenectady, NY
 Technical Report
 Rept No : DE82-000649, 54 pp., 1981 (AD-D125 182)
Key Words: FSX-414, IN-738, GTD-111, turbine components, coatings, erosion,
 hot corrosion

31. **European Concerted Action COST 50--Materials for Gas Turbines UK17--An Investigation of the Creep Fracture Process in a Cast Ni-Cr Base Alloy, IN738LC**
 Tipler, H. R., Peck, M. S.
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 Rept No : NPL-DMA-A-33, 118 pp., 1981 (AD-D128 455)
Key Words: IN-738LC, turbine components, cracking, porosity, creep rupture, tensile properties

32. **Heat Treatment of Hot Isostatically Processed IN-738 Investment Castings**
 Beddoes, J. C., Wallace, W.
 Metall 13 (2), 185-94, 1980 (AD-D118 440)
Key Words: IN-738, turbine components, creep rupture twinning, heat treatment

33. **Cutting Metal Loss Tied to Near Net Shapes**
 Harvey, R. E.
 Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

34. **Hot Isostatic Processing of IN-738 Turbine Blades**
 Van Drunen, G., Liburdi, J., Wallace, W., Teradach, T.
 Westinghouse Canada Ltd. Hamilton (Ontario) Turbine and Generator Div
 Proc 47th Meeting of the AGARD Structures and Materials Panel, Advanced Fabrication Processes
 Rept No : AGARD-CP-256, 13-1 to 13-12, 1979 (AD-D117 188)
Key Words: IN-738, turbine components, creep rupture, tensile properties, fatigue, Larsen-Miller curves, thermal cycling

35. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
 Tipler, H. R., Lindblom, Y., Davidson, J. G.
 Applied Sciences Publishers Ltd., London, UK
 Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

36. **Quality of Castings of Superalloys**
 Bachelet, E., Lesoult, G.
 Applied Sciences Publishers Ltd., London, UK
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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

37. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
 McColvin, G. M.
 NTIS, N79-18022, Springfield, VA
 Final Report
 Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

38. **Premium Quality Castings**
 Freeman Jr., W. R.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

39. **Improved Properties in Castings by Hot Isostatic Pressing**
 Glenn, G. M.
 SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355
 porosity, tensile properties, microstructure, creep rupture, density, fatigue

40. **Processing: The Rediscovered Dimension in High Temperature Alloys**
 Semchyshen, M.
 Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

41. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A.
 SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

42. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
 Mueller, J. J.
 Electric Power Research Inst, Palo Alto, CA
 Phase One Survey Report
 Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

43. **Study of Superalloys Produced via Powder Metallurgy**
 Hellner, L., Johansson, H.
 NTIS, N77-13210, Springfield, VA
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 Rept No : N77-13210, 56 pp., 1975 (AD-D109 492)
Key Words: X-40, MAR-M509, IN-738, dispersion hardening, cracking, microstructure, temperature effect, deformation, stress intensity, tensile properties

IN-792

1. **Hot Isostatic Press**
 Author Anon
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

2. **Polycrystalline Grain Controlled Castings for Rotating Compressor and Turbine Components**
Ewing, B. A., Green, K. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 33-42, 1984 (AD-D132 824)
Key Words: Microcast X, IN-792, MAR-M247, AF-95, turbine components, microstructure, tensile properties, creep rupture
3. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue
4. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity
5. **Applications of Composite Gas Turbine Components**
Peterson, L. G., Hreencecin, D. E., Carreno, D. E., Beltran, A. M., Schilling, W. F.
General Electric Co., Gas Turbine Division, Schenectady, NY
Semi-Annual Technical Progress Rept-Phase I
Rept No : DE82-004710, 30 pp., 1981 (AD-D125 782)
Key Words: MAR-M200, Udimet 700, IN-792, turbine components, tensile properties, creep, fatigue, diffusion bonding, unidirectional solidification
6. **A Solid-to-Solid HIP Bond Pressing Concept for the Manufacturing of Dual-Property Turbine-Wheels for Small Gas Turbines**
Ewing, B. A.
ASM International, Metals Park, OH
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Key Words: MAR-M246, IN-792, turbine components, net shape forming, diffusion bonding, dissimilar joining, tensile properties, thermal fatigue
7. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure
8. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E.
Iron Age 222 (42), 57-63, 1979 (AD-D116 853)
Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties
9. **HIP, the Great Healer of Castings**
Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

10. **HIP'ing Raises Casting Performance Levels**
 Freeman, W. R., Jr., Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

11. **Premium Quality Castings**
 Freeman Jr., W. R.
 Manufacturing Technology Division, AFMIL, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue

12. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

13. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
 Mueller, J. J., Electric Power Research Inst, Palo Alto, CA
 Phase One Survey Report
 Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

IN-939

1. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
 Quested, P. N., Osgerby, S.
 Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

2. **Creep Dominated Damage Processes**
 Hoffelner, W., Kluwer Academic Publishers, Norwell, MA
 Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 413-39, 1986 (AD-D142 074)
Key Words: Incoloy 800H, IN-738LC, IN-939, microstructure, creep, corrosive environment

3. **Effect of Fabrication and Repair Procedures on the Performance of IN 738 LC and IN 939**
 Esser, W., McLean, M., Schneider, K.
 Kluwer Academic Publishers, Norwell, MA
 Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 593-622, 1986 (AD-D142 076)
Key Words: IN-738LC, IN-939, turbine components, welding, gas tungsten arc welding, electron beam welding, creep rupture strength, hot corrosion, welding, tensile properties, fatigue

4. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

5. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

6. **High Cycle Fatigue Properties of Cast Nickel Base Superalloys IN 738LC and IN 939**
Schneider, K., Gnirrs, G., McColvin, G.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 319-44, 1982 (AD-D133 996)
Key Words: IN-738C, IN-939, grain size, porosity, particle size, fatigue

7. **Mechanisms of High Cycle Fatigue of Cast Nickel Base Alloys**
Schneider, K., Gnirrs, G., Truck, B., Arnim, G. V.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 685-701, 1982 (AD-D134 014)
Key Words: IN-738LC, IN-939, grain refinement, crack initiation, fatigue life

8. **Quality of Castings of Superalloys**
Bachelet, E., Lesoult, G., Applied Sciences Publishers Ltd., London, UK
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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

Incoloy 901

1. **Fatigue Dominated Damage Processes**
Bressers, J., Remy, L., Hoffelner, W.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1 441-68, 1986 (AD-D142 075)
Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

2. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic Durability by Analysis and Testing, Lisse, Netherlands
10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining

3. **Materials for Advanced Turbine Engine--MATE**
 Evans, D. J., Sheffler, K. D., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, East Hartford, CT
 Contract No : NAS 3-20072, 1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening
4. **Materials for Advanced Turbine Engine-MATE**
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 Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
 Quarterly Technical Progress Report Number Twenty, Dec 80-Feb 81
 Contract No : NAS 3-20072, 48 pp., 1981 (AD-D120 953)
Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue
5. **Aircraft Gas Turbine Materials and Processes**
 Kear, B. H., Thompson, E. R.
 Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming
6. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
 McColvin, G. M.
 NTIS, N79-18022, Springfield, VA
 Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

Inconel 625

1. **Cast 625 Hot Isostatic Pressing (HIP) Parameters - a Statistically Designed Study**
 Carlson, R. G.
 TMS, Warrendale, PA
 Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 97-106, 1991
Key Words: Inconel 625, tensile properties, computer model, defects
2. **Severe Sour Gas Service Performance of HIP-Clad Alloy 625**
 Bednarowicz, T. A., Byrd, J. D., Raymond, E. L., Bunch, P. D.
 Materials Performance 28 (1), 59-63, 1989 (AD-D140 727)
Key Words: Inconel 625, corrosive medium, sour gas wells
3. **Repair Techniques for Gas Turbine Components**
 Liburdi, J.
 Liburdi Engineering Ltd. Burlington, Ontario, Canada
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 Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion brazing, vacuum deposition, tensile properties, creep rupture

4. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid solidification, injection molding

Inconel 718

1. **The Effect of Laves Phase on the Mechanical Properties of Wrought and Cast + HIP Inconel 718**
Schirra, J. J., Caless, R. H., Hatala, R. W., TMS, Warrendale, PA
Proc Int Symp Metall Appl Superalloys 718, 625 Var Deriv 375-88, 1991
Key Words: Inconel 718, tensile properties, microstructure, fracture toughness, impact toughness, fatigue, cracking
2. **An Evaluation of the Effects of Filler Metal Composition on Cast Alloy 718 Simulated Repair Welds**
Kelly, T. J., Cremisio, W. H., Simon, W. H.
Weld J 68 (1), 14-s to 18-s, 1989 (AD-D140 251)
Key Words: Inconel 718, microstructure, HAZ, welding, fatigue
3. **Elemental Effects on Cast 718 Weldability**
Kelly, T. J., Weld J 68 (2), 44-s to 51-s, 1989 (AD-D140 721)
Key Words: Inconel 718, turbine components, microstructure, tensile properties, rupture strength, welding
4. **Near-Threshold Crack Growth in Nickel-Base Superalloys**
Van Stone, R. H., Krueger, D. D., ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 883-906, 1988 (AD-D139 966)
Key Words: RENE' 95, Inconel 718, microstructure, grain size, fatigue crack growth, tensile properties
5. **Microstructure and Properties of Ni-Fe Base Ta-718**
Loewenkamp, S.A., Radavich, J.F., Kelly, T.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 53-62, 1988 (AD-D142 283)
Key Words: Inconel 718, microstructure, tensile properties creep rupture
6. **Effect of HIP Parameters on Fine Grain Cast Alloy 718**
Siereveld, P., Radavich, J.F., Kelly, T., Cole, G., Widmer, R.
The Metallurgical Society of AIME, Warrendale, PA
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Key Words: Inconel 718, microscopy, grain growth, porosity, heat treating, tensile properties
7. **Effects of Thermal and Thermo-Mechanical Treatments on the Mechanical Properties of Centrifugally Cast Alloy 718**
Michel, D. J., Smith, H. H., Naval Research Lab, Washington DC
Rept No : NRL-MR-6101, 22 pp., 1987 (AD-A188 195)
Key Words: Inconel 718, fatigue, crack growth, creep rupture microstructure, crystallography, brittle fracture, aging, thermomechanical treatment, homogenizing

8. **The Role of Hot Isostatic Pressing--Now and in the Future**
 Widmer, R.
 ASM International, Metals Park, OH
 Proc Nicholas J. Grant Symp, Processing and Properties of Advanced High Temperature Alloys
 105-16, 1986 (AD-D139 357)
 Key Words: Udimet 700, Inconel 718, densification, fatigue, creep rupture

9. **Fatigue Dominated Damage Processes**
 Bressers, J., Remy, L., Hoffelner, W.
 Kluwer Academic Publishers, Norwell, MA
 Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
 441-68, 1986 (AD-D142 075)
 Key Words: MAR-M509, IN-738LC, Hastelloy X, Inconel 617, RA-333, A-286, Inconel 718, Incoloy 901, microstructure, cracking, granular fracture, fatigue

10. **Effects of Trace Elements on Mechanical Properties of Superalloys**
 McLean, M., Strang, A.
 Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
 Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture

11. **Fatigue Growth of Surface Cracks in Nickel-Based Superalloys**
 Brown, C. W., Hicks, M. A.
 Int J Fatigue 4 (2), 73-81, 1982 (AD-D124 743)
 Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

12. **Hot Isostatic Pressing of Alloy IN-718**
 Lamberigts, M., Herman, C., Louis, P., Wallemacq, J. P., Drapier, J. M.
 Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 999-1011, 1982 (AD-D134 030)
 Key Words: Inconel 718, turbine components, welding, tensile properties, creep rupture

13. **Healing Defects by HIP**
 Dreger, D. R.
 Mach Des 53 (12), 79-85, 1981 (AD-D121 264)
 Key Words: Inconel 718, porosity, welding, cracking, fatigue, creep, tensile properties

14. **Use of a d-c Potential Drop Crack Monitoring Technique in the Development of Defect Tolerant Disk Alloys**
 Van Stone, R. H., Krueger, D. D., Duvelius, L. T.
 ASTM, Philadelphia, PA
 Proc 14th National Symp Fracture Mechanics 2, 553-78, 1981 (AD-D128 740)
 Key Words: RENE' 95, Inconel 718, turbine components, microstructure, tensile properties, crack growth, fatigue,

15. **Process Optimization of Cast Alloy 718 for Water Cooled Gas Turbine Application**
 Bouse, G. K., Schilke, P. W.
 ASM International, Metals Park, OH
 Proc 4th Int Symp Superalloys, Superalloys 1980 303-10, 1980 (AD-D120 660)
 Key Words: Inconel 718, turbine components, dislocation structure, homogenizing, tensile properties

16. **New Method for Cast Superalloy Frames**
 Schweikert, W., Bailey, P. G.
 U.S. Army Mantech J 5 (3), 28-32, 1980 (AD-D126 145)
Key Words: Inconel 718, turbine components, fatigue, microstructure, welding, chemical milling

17. **Investigation of Rejuvenation of Fatigue Damage in IN-718**
 Clauer, A. H., Leis, B. N., Hoover, G., Seifert, D. A.
 Battelle Memorial Institute, Columbus, OH
 Final Report
 Rept No : AFML-TR-78-90, 115 pp., 1978 (AD-A068 333)
Key Words: IN-718, microstructure, rejuvenation, fatigue, tensile properties

18. **HIP, the Great Healer of Castings**
 Bittence, J. C.
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Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost

19. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
 Billard, D., Trottier, J. P.
 Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect

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Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

21. **Superalloy Casting Process**
 Schweikert, W. H., Piwonka, T. S.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 93-116, 1976 (AD-D119 169L)
Key Words: Inconel 718, forging, turbine components, tensile properties, fatigue

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 Schweikert, W. H.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
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Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

23. **Processing: The Rediscovered Dimension in High Temperature Alloys**
 Semchyshen, M.
 Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture

24. **Precision Castings State-of-the-Art**
Nagan, R. M., SAMPE Qtrly 6 (4), 1-7, 1975 (AD-D102 565)
Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties
25. **Complex Rotor Fabrication by Hot Isostatic Pressure Welding**
Lessman, G. G., Bryant, W. A.
Weld J 51 (12), 606s-614s, 1972 (AD-180 534)
Key Words: AISI 4340, Inconel 718, hardness, tensile properties

Inconel X-750

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baldan, A., J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation
2. **Repair Techniques for Gas Turbine Components**
Liburdi, J., Liburdi Engineering Ltd. Burlington, Ontario, Canada
Proc 61st Meeting of the AGARD Structures and Materials Panel, Advanced Joining of Aerospace Metallic Materials
Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion brazing, vacuum deposition, tensile properties, creep rupture
3. **Creep Life Predictions in Nickel-based Superalloys**
Koul, A. K., Castillo, R., Willett, K.
Mater Sci Eng 66 (2), 213-26, 1984 (AD-D131 247)
Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components, deformation, grain size, long term tests, shear stress
4. **Effects of Trace Elements on Mechanical Properties of Superalloys**
McLean, M., Strang, A., Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain boundaries, porosity, creep rupture
5. **Problems and Possibilities for Life Extension in Gas Turbine Components**
Koul, A. K., Wallace, W., Thamburaj, R.
National Aeronautical Establishment, Structures and Materials Section
Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic Durability by Analysis and Testing, Lisse, Netherlands
10-1 to 10-32, 1984 (AD-D132 383)
Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine components, damage tolerance, EDM, creep, machining
6. **Fatigue Growth of Surface Cracks in Nickel-Based Superalloys**
Brown, C. W., Hicks, M. A.
Int J Fatigue 4 (2), 73-81, 1982 (AD-D124 743)
Key Words: Inconel X-750, Inconel 718, turbine components, microstructure, grain size, crack growth, fatigue, tensile properties

7. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
 Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
 Westinghouse Canada Ltd., Hamilton, Ontario, Canada
 Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in
 Service of High Temperature Parts
 10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700,
 turbine components, microstructure, rejuvenation, creep

8. **HIP Processing--Potentials and Applications**
 Van Der Vet, W. J.
 Chromalloy American Co., Midwest City, OK
 Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in
 Service of High Temperature Parts
 11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738,
 IN-782, turbine components, fatigue, thermal cycling, creep rupture

MAR-M002

1. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
 Quested, P. N., Osgerby, S.
 Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002,
 MAR-M247, Alloy 713LC, unidirectional solidification, creep

2. **Effects of Trace Elements on Mechanical Properties of Superalloys**
 McLean, M., Strang, A.
 Met Technol 11 (10), 454-64, 1984 (AD-D131 862)
Key Words: IN-100, MAR-M002, IN-738, IN-939, IN-718, Inconel X-750, grain
 boundaries, porosity, creep rupture

3. **Characterizations of Elevated Temperature Fatigue Crack Growth Rates**
 Crompton, J. S., Morley, S. A., Martin, J. W.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc 5th Int Symp Superalloys 1984 761-9, 1984 (AD-D132 885)
Key Words: MAR-M002, Nimonic AP1, unidirectional solidification, fatigue
 crack, stress relaxation

4. **The Effect of Hot Isostatic Pressing on the Creep and Fracture Behavior of the Cast Superalloy MAR-M002**
 Burt, H., Dennison, J. P., Elliott, I. C., Wilshire, B.
 Mater Sci Eng 53 (2), 245-50, 1982 (AD-D125 089)
Key Words: MAR-M002, microstructure, porosity, cracking, surface defects,
 fracture mechanics, creep, ductility

5. **HIP'ing Various Precision Cast Engine Components in Nickel-Based Superalloys**
 Lamberigts, M., Diderrich, E., Coutsouradis, D., de Lamotte, E., Drapier, J. M.
 Proc 4th Int Symp Superalloys, Superalloys 1980 285-94, 1980 (AD-D120 658)
Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines,
 turbine components, creep, microstructure

6. **Casting Conditions, Microstructure and Creep Properties of MAR-M-002 Blades**
 Viatour, P., Coutsouradis, D., Habraken, L., Drapier, J. M.
 Applied Sciences Publishers Ltd., London, UK
 Proc Conf High Temperature Alloys for Gas Turbines 875-91, 1978 (AD-D116 366)
Key Words: MAR-M002, turbine components, rotor blades, microstructure,
 porosity, grain boundaries, creep rupture, precipitation,
 segregation, thermomechanical treatment

MAR-M200

1. **Microstructural Damages Induced During the Repair Process**
 Davin, A., Lecomte-Mertens, Ch., Vierset, P., Louis, P.
 Kluwer Academic Publishers, Norwell, MA
 Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
 811-20, 1986 (AD-D142 085)
Key Words: Haynes 188, MAR-M200, X-40, turbine components, tensile
 properties, thermal shock, diffusion brazing, rejuvenation, repairs, welding
2. **Structural Damage and Rejuvenation of Used Turbine Blades**
 Lamberigts, M., Lecomte-Mertens, Ch., Vierset, P.
 Kluwer Academic Publishers, Norwell, MA
 Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 1
 821-30, 1986 (AD-D142 086)
Key Words: MAR-M200, turbine components, microstructure, aging, rupture
 strength, service life, rejuvenation
3. **Creep Life Predictions in Nickel-based Superalloys**
 Koul, A. K., Castillo, R., Willett, K.
 Mater Sci Eng 66 (2), 213-26, 1984 (AD-D131 247)
Key Words: MAR-M200, IN-738LC, Inconel X-750, turbine components,
 deformation, grain size, long term tests, shear stress
4. **Development of Hybrid Gas Turbine Bucket Technology**
 Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
 General Electric Co., Gas Turbine Division, Schenectady, NY
 Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125,
 RENE' 120, GTD-111, IN-738, turbine components, tensile
 properties, unidirectional solidification, dissimilar joining,
 diffusion bonding, creep rupture
5. **Superalloy Technology-Today and Tomorrow**
 VerSnyder, F. L., Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 1-49, 1982 (AD-D133 988)
Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition,
 zirconium addition, cobalt addition, turbine components,
 corrosion, oxidation, REP, creep rupture, thermal fatigue
6. **Precision Casting of Turbine Blades and Vanes**
 Drapier, J. M., Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine
 components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

7. **Applications of Composite Gas Turbine Components**
 Peterson, L. G., Hrencecin, D. E., Carreno, D. E., Beltran, A. M., Schilling, W. F.
 General Electric Co., Gas Turbine Division, Schenectady, NY
 Rept No : DE82-004710, 30 pp., 1981 (AD-D125 782)
Key Words: MAR-M200, Udimet 700, IN-792, turbine components, tensile
 properties, creep, fatigue, diffusion bonding, unidirectional solidification

8. **HIP Rejuvenation of Damaged Blades**
 Stewart, D. C., Bennett, G. T.
 Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
 Interim Technical Report One and Two, Aug 77-Mar 79
 Rept No : FR-11642, 115 pp., 1979 (AD-D108 398L)
Key Words: IN-100, MAR-M200, unidirectional solidification, creep properties,
 aluminides, PWA 73 coating, surface defects, rejuvenation

9. **The Promise of more Heat Resistant Turbine Materials**
 Freche, J. C., Ault, G. M.
 Prod Engineering 50 (7), 35-9, 1979 (AD-D115 942)
Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E,
 WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile
 properties, coatings, corrosion, thermal fatigue,
 unidirectional solidification

10. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
 Tipler, H. R., Lindblom, Y., Davidson, J. G.
 Applied Sciences Publishers Ltd., London, UK
 Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500,
 Udimet 710, Udimet 720, turbine components, microstructure,
 grain boundaries, cracking, creep properties, fatigue, thermal
 fatigue, cavitation corrosion

11. **Coatings for Directionally Solidified Gamma Prime-Gamma Plus Alpha Eutectics**
 Smeggil, J.
 United Technologies Research Center, East Hartford, CT
 Rept No : R77-912959-1, 12 pp., 1977 (AD-D108 260)
Key Words: MAR-M200, hafnium addition, nickel aluminide coatings, CoCrAlY
 coatings, NiCoCrAlY coatings, platinum addition, thermal
 expansion, oxidation, sulfidation, unidirectional
 solidification

12. **Premium Quality Castings**
 Freeman Jr., W. R.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 406-17, 1976 (AD-D119 187L)
Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900,
 MAR-M200, tensile properties, fatigue

13. **Cost/Benefit Analysis of Advanced Materials Technologies for Future Aircraft Turbine Engines**
 Bisset, J. W.
 United Technologies Corp., East Hartford, CT
 Rept No : N77-14026, PWA-5453, 42 pp., 1976 (AD-D107 956)
Key Words: MAR-M509, Hastelloy X, Waspaloy, IN-100, MAR-M200, turbine
 components, single crystals, hafnium addition, unidirectional solidification, cost

14. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

MAR-M246

1. **Advanced Single Crystal for SSME Turbopumps**
 Fritzemeier, L. G., Rockwell International, Rocketdyne Div, Canoga Park, CA
 Contract No : NAS3-24646, 8 pp., 1988 (AD-D138 556)
Key Words: MAR-M246, fatigue, creep rupture, tensile properties
2. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
 Quested, P. N., Osgerby, S.
 Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep
3. **A Solid-to-Solid HIP Bond Pressing Concept for the Manufacturing of Dual-Property Turbine-Wheels for Small Gas Turbines**
 Ewing, B. A., ASM International, Metals Park, OH
 Proc 4th Int Symp Superalloys, Superalloys 1980 169-78, 1980 (AD-D120 647)
Key Words: MAR-M246, IN-792, turbine components, net shape forming, diffusion bonding, dissimilar joining, tensile properties, thermal fatigue
4. **The Metallurgical Aspects of Hot Isostatically Pressed Superalloy Castings**
 Antony, K. C., Radavich, J. F.
 Proc 4th Int Symp Superalloys, Superalloys 1980 257-65, 1980 (AD-D120 655)
Key Words: Alloy 713C, MAR-M246, microstructure, porosity, tensile properties, creep rupture, fatigue, fracture toughness

MAR-M247

1. **Manufacturing Processes for Long-Life Gas Turbines**
 Hoppin, G. S., III, Danesi, W. P.
 J Met 38 (7), 20-3, 1986 (AD-D136 463)
Key Words: MAR-M247, turbine components, diffusion bonding
2. **Metallurgical Advancements in Investment Casting Technology**
 Dardi, L. E., Dalal, R. P., Yaker, C.
 ASM International, Metals Park, OH
 Proc Nicholas J. Grant Symp, Processing and Properties of Advanced High Temperature Alloys
 25-39, 1986 (AD-D139 354)
Key Words: MAR-M247, Ni-7Al-14Mo, Ti-6Al-4V, turbine components, fatigue properties, unidirectional solidification

3. **Mechanical Properties of Conventionally Cast, Directionally Solidified, and Single-Crystal Superalloys**
 Quested, P. N., Osgerby, S.
 Mater Sci Technol 2 (5), 461-75, 1986 (AD-D140 385)
Key Words: IN-935, IN-738, IN-939, IN-597, IN-738LC, MAR-M246, MAR-M002, MAR-M247, Alloy 713LC, unidirectional solidification, creep

4. **Development of a Conventional Fine Grain Casting Process**
 Woulds, M., Benson, H.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc 5th Int Symp Superalloys 1984 3-12, 1984 (AD-D132 821)
Key Words: Alloy 713LC, MAR-M247, turbine components, microstructure, creep rupture, tensile properties, fatigue

5. **Polycrystalline Grain Controlled Castings for Rotating Compressor and Turbine Components**
 Ewing, B. A., Green, K. A.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc 5th Int Symp Superalloys 1984 33-42, 1984 (AD-D132 824)
Key Words: Microcast X, IN-792, MAR-M247, AF-95, turbine components, microstructure, tensile properties, creep rupture

6. **Properties of Cast MAR-M-247 for Turbine Blisk Applications**
 Kaufman, M.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc 5th Int Symp Superalloys 1984 43-52, 1984 (AD-D132 825)
Key Words: MAR-M247, turbine components, defects, crack growth, tensile properties, fatigue, threshold stress

7. **Precision Casting of Turbine Blades and Vanes**
 Drapier, J. M.
 Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 887-908, 1982 (AD-D134 025)
Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

MERL 76

1. **Development of Gatorized(R) MERL 76 for Gas Turbine Disk Applications**
 Caless, R.H., Paulonis, D.F.
 The Metallurgical Society of AIME, Warrendale, PA
 Proc 6th Int Symp Superalloys 1988 101-10, 1988 (AD-D142 288)
Key Words: MERL 76, turbine components, grain size, crack growth, tensile properties, flow stress, gatorizing, fatigue

2. **On the Sintered Ni-Base Superalloy (VI)--Effect of Microstructures on the Creep Property**
 Morishita, M., Nagai, H., Shoji, K.
 J Jpn Soc Powder Metall 33 (7), 373-8, 1986 (AD-D136 163)
Key Words: IN-100, MERL 76, microstructure, swaging, creep rate, liquid sintering, creep rupture

3. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
Plenum Press, New York, NY
Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

4. **Materials for Advanced Turbine Engine--MATE**
Evans, D. J., Sheffler, K. D., Friedrich, L. A.
Pratt and Whitney Aircraft Group, East Hartford, CT
Mar-May 82
Contract No : NAS 3-20072
1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

5. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
Davidson, J. H., Aubin, C.
Kluwer Boston Inc., Hingham, MA
Proc Conf High Temperature Alloys for Gas Turbines 853-86, 1982 (AD-D134 024)
Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components, microstructure, crack propagation, fatigue, creep rupture, impact, thermomechanical treatment

6. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity

7. **Materials for Advanced Turbine Engine-MATE**
Evans, D. J., Henricks, R. J., Friedrich, L. A.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Quarterly Technical Progress Report Number Twenty, Dec 80-Feb 81
Contract No : NAS 3-20072
48 pp., 1981 (AD-D120 953)
Key Words: MERL 76, MA956, Hastelloy X, Incoloy 901, aircraft structures, combustor liners, turbine components, tensile properties, creep, crack growth, coatings, thermal fatigue

Nimonic 90

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Bildan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **Repair and Regeneration of Turbine Blades, Vanes, and Discs**
Huff, H., Wortmann, J.
Motoren und Turbinen Union GMBH, Munich, Germany
Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in Service of High Temperature Parts
13-1 to 13-7, 1982 (AD-D125 470)
Key Words: IN-100, Nimonic 90, Nimonic 108, turbine components, welding, creep, rejuvenation

3. **Scope for Repair Welding Gas Turbine Blades**
Elsner, W.
Pract Metall 19 (4), 199-214, 1982 (AD-D126 799)
Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components, microstructure, tensile properties, welding

4. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

Nimonic 105

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by Heat Treatment and Hot Isostatic Pressing Techniques**
Baidan, A.
J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic 90, IN-738, IN-738LC, Inconel X-750, turbine components, creep, grain size, cavitation

2. **The Behavior of NIM 105 and IN738 LC Under Creep and LCF Testing**
Persson, P.-O., Persson, C., Burman, G., Lindblom, Y.
Kluwer Academic Publishers, Norwell, MA
Proc High Temperature Alloys for Gas Turbines and Other Applications 1986-Part 2
1501-15, 1986 (AD-D142 159)
Key Words: Nimonic 105, IN-738LC, fatigue strain, creep

3. **Refurbishing Superalloy Components for Gas Turbines**
Lindblom, Y.
Mater Sci Technol 1 (8), 636-41 and 643, 1985 (AD-D133 819)
Key Words: Nimonic 105, turbine components, coatings, repairs, microstructure, rejuvenation, creep rate, fatigue

4. **Refurbishing Superalloy Components for Gas Turbines**
Lindblom, Y.
Mater Sci Technol 1 (8), 636-41, 1985 (AD-D319 428)
Key Words: Nimonic 105, turbine components, SEM, optical microscopy, blade life, creep

5. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
 Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
 Westinghouse Canada Ltd., Hamilton, Ontario, Canada
 Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in
 Service of High Temperature Parts, 10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700,
 turbine components, microstructure, rejuvenation, creep

6. **HIP Processing--Potentials and Applications**
 Van Der Vet, W. J., Chromalloy American Co., Midwest City, OK
 Proc 53rd Meeting of the AGARD Structures and Materials Panel,
 Maintenance in, Service of High Temperature Parts
 11-1 to 11-16, 1982 (AD-D125 468)
Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738,
 IN-782, turbine components, fatigue, thermal cycling, creep rupture

7. **Scope for Repair Welding Gas Turbine Blades**
 Elsner, W., Pract Metall 19 (4), 199-214, 1982 (AD-D126 799)
Key Words: IN-738LC, Nimonic 90, Nimonic 105, Udimet 520, turbine components,
 microstructure, tensile properties, welding

8. **An Assessment of Hot Isostatic Pressing and Reheat Treatment for the Regeneration of
 Creep Properties of Superalloys**
 Dennison, J. P., Elliot, I. C., Wilshire, B.
 ASM International, Metals Park, OH
 Proc 4th Int Symp Superalloys, Superalloys 1980 671-77, 1980 (AD-D120 696)
Key Words: Nimonic 105, IN-100, fracture mechanics, creep, heat treatment

Nimonic 115

1. **Rejuvenation Procedures to Recover Creep Properties of Nickel-Base Superalloys by
 Heat Treatment and Hot Isostatic Pressing Techniques**
 Baldan, A., J Mater Sci 26 (13), 3409-21, 1991
Key Words: IN-100, Nimonic 80A, Nimonic 115, Nimonic 75, Nimonic 105, Nimonic
 90, IN-738, IN-738LC, Inconel X-750, turbine components,
 creep, grain size, cavitation

2. **Rejuvenation of Used Turbine Blades by Hot Isostatic Pressing and Reheat Treatment**
 Cheung, K. L., Leach, C. C., Willett, K. P., Koul, A. K.
 Westinghouse Canada Ltd., Hamilton, Ontario, Canada
 Proc 53rd Meeting of the AGARD Structures and Materials Panel, Maintenance in
 Service of High Temperature Parts, 10-1 to 10-6, 1982 (AD-D125 467)
Key Words: Inconel X-750, IN-738, Nimonic 115, Nimonic 105, Inconel 700,
 turbine components, microstructure, rejuvenation, creep

3. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
 Tipler, H. R., Lindblom, Y., Davidson, J. G.
 Applied Sciences Publishers Ltd., London, UK
 Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500,
 Udimet 710, Udimet 720, turbine components, microstructure,
 grain boundaries, cracking, creep properties, fatigue, thermal
 fatigue, cavitation corrosion

4. **High Cycle Fatigue of Nickel-Base Alloys-European Concerted Action-- Cost 50-Materials for Gas Turbines, Project UK8**
McColvin, G. M.
NTIS, N79-18022, Springfield, VA
Final Report
Rept No : N79-18022, T.R. 2977, 99 pp., 1977 (AD-D115 653)
Key Words: Incoloy 901, IN-738, Nimonic 90, Nimonic 115, Inconel 718, fatigue, tensile properties, creep rupture, grain size

PWA 1480

1. **The Role of the gamma/gamma prime Eutectic and Porosity on the Tensile Behavior of a Single-Crystal Nickel-Base Superalloy**
Walston, W. S., Bernstein, I. M., Thompson, A. W.
Metall Trans A 22A, 1443-51, 1991
Key Words: PWA 1480, tensile properties, porosity, fracture, single crystals
2. **Advanced Single Crystal for SSME Turbopumps**
Fritzemeier, L. G.
Rockwell International, Rocketdyne Div, Canoga Park, CA
Final Contractor Report
Rept No : RI/RD 88-273, N89-21072, 48 pp., 1989 (AD-D141 694)
Key Words: PWA 1480, space shuttle, turbine components, porosity, crack propagation, tensile properties, creep, rupture strength, fatigue
3. **The Influence of High Thermal Gradient Casting, Hot Isostatic Pressing and Alternate Heat Treatment on the Structure and Properties of a Single Crystal Nickel Base Superalloy**
Fritzemeier, L.G.
The Metallurgical Society of AIME, Warrendale, PA
Proc 6th Int Symp Superalloys 1988 265-74, 1988 (AD-D142 299)
Key Words: PWA 1480, space shuttle, porosity, creep rupture, tensile properties, fatigue, hydrogen environment
4. **Advanced Single Crystal for SSME Turbopumps**
Fritzemeier, L. G.
Rockwell International, Rocketdyne Div, Canoga Park, CA
Quarterly Technical Progress Report, Mar-Jun 87
Contract No : NAS3-24646
6 pp., 1987 (AD-D138 334)
Key Words: PWA 1480, defects, tensile properties, fatigue
5. **Mechanical Behavior and Processing of DS and Single Crystal Superalloys**
Khan, T., Caron, P., Nakagawa, Y. G.
J Met 38 (7), 16-9, 1986 (AD-D136 462)
Key Words: CMSX2, PWA 1480, Alloy 454, tensile properties, creep rupture, fatigue
6. **Precision Casting of Turbine Blades and Vanes**
Drapier, J. M.
Kluwer Boston Inc., Hingham, MA
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Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

Rene' 80

1. **High Pressure Turbine Blade Life Extension**
Smith, H. H., Michel, D. J.
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Final Memorandum Report
Rept No : NRL-MR-6861, 47 pp., 1991 (AD-A240 654)
Key Words: RENE' 80H, MERL 72, turbine components, tensile properties creep rupture, microstructure, welding
2. **Deformation Mechanisms of Thermostructural Materials**
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Rept No : 162, 46 pp., 1987 (AD-A184 070)
Key Words: IN-100, RENE' 80, turbine components, CoCrAl coatings, creep rupture, thermal fatigue, barrier coatings, dislocation
3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4
4. **A Mechanistically Based Model for High Temperature Notched LCF of RENE' 80**
Domas, P. A., Antolovich, S. D.
Eng Fract Mechanics 21 (1), 203-14, 1985 (AD-D131 953)
Key Words: RENE' 80, microstructure, heat treatment, fatigue, tensile properties
5. **Hipping is One Way to Check Porosity in Cast Components**
Irving, R. R.
Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISI 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue
6. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture
7. **Turbine Blade Technology--Present and Future**
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Key Words: RENE' 80, RENE' 150, turbine components, aircraft structures, coatings, welding

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Key Words: IN-792, IN-738, IN-100, RENE' 80, Alloy 713L, Alloy 713LC, B-1900, MAR-M200, tensile properties, fatigue
9. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M., SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355
porosity, tensile properties, microstructure, creep rupture, density, fatigue
10. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
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Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture
11. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J., Electric Power Research Inst, Palo Alto, CA
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

Rene' 95

1. **Constraint-Loss Model for the Growth of Surface Fatigue Cracks**
Van Stone, R. H., Gilbert, M. S., Gooden, O. C., Laflen, J. H.
ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 637-56, 1988 (AD-D139 960)
Key Words: RENE' 95, surface defects, fracture mechanics, fatigue crack growth
2. **Near-Threshold Crack Growth in Nickel-Base Superalloys**
Van Stone, R. H., Krueger, D. D.
ASTM, Philadelphia, PA
Proc Fracture Mechanics, Nineteenth Symp
Rept No : ASTM-STP-969, 883-906, 1988 (AD-D139 966)
Key Words: RENE' 95, Inconel 718, microstructure, grain size, fatigue crack growth, tensile properties
3. **Modelling of Deformation and Microstructural Changes in P/M RENE' 95 Under Isothermal Forging Conditions**
Alniak, O., Morphy, D. D., Terada, T., Koul, A. K., Immarrigeon, J-P.
National Aeronautical Establishment, Ottawa, Canada
Proc 65th Meeting of the AGARD Structures and Materials Panel
2-1 to 2-18, 1987 (AD-D140 764)
Key Words: RENE' 95, microstructure, grain refinement, deformation, flow stress, compression tests

4. **Advanced Machining Research Program (AMRP). Volume 5. Economic Modeling**
 Flom, D. G.
 General Electric Corporate Research and Development, Schenectady, NY
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 Rept No : AFWAL-TR-84-4059-Vol-5, 230 pp., 1984 (AD-B088 346L)
 Key Words: Ti-6Al-4V, RENE' 95, turbine components, gun tubes, laser
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5. **Effects of Processing and Microstructure on the Fatigue Behavior of the Nickel-Base Superalloy RENE' 95**
 Miner, R. V., Gayda, J.
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 Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue,
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 tensile properties, microstructure,

7. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
 Coffin, L. F.
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 Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76,
 IN-100, NASA IIB-7, crack growth, fatigue

8. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
 Davidson, J. H., Aubin, C.
 Kluwer Boston Inc., Hingham, MA
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 Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components,
 microstructure, crack propagation, fatigue, creep rupture,
 impact, thermomechanical treatment

9. **Use of a d-c Potential Drop Crack Monitoring Technique in the Development of Defect Tolerant Disk Alloys**
 Van Stone, R. H., Krueger, D. D., Duvelius, L. T.
 ASTM, Philadelphia, PA
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 Key Words: RENE' 95, Inconel 718, turbine components, microstructure, tensile
 properties, crack growth, fatigue,

10. **Review of Superalloy Powder Metallurgy Processing for Aircraft Gas Turbine Applications**
 Bartos, J. L.
 ASTM, Philadelphia, PA
 Proc Symp MiCon 78, 564-77, 1979 (AD-D126 411)
 Key Words: RENE' 95, turbine components, tensile properties, creep rupture,
 net shape forming

11. **Material for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Eighth Quarterly Engineering Report One, Dec-Feb 78
Rept No : R78AEG265, 111 pp., 1978 (AD-D112 563)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, creep properties, crack growth, notch sensitivity, tensile properties, thermal properties, oxidation, corrosion, fatigue
12. **Materials for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Ninth Quarterly Engineering Report, Mar-May 78
Rept No : R78AEG356, 20 pp., 1978 (AD-D113 124)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, coatings, microstructure, net shape forming
13. **Material for Advanced Turbine Engines-MATE**
Arnold, D. B., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Ten, Jun-Aug 78
Rept No : R78AEG496, 56 pp., 1978 (AD-D113 898)
Key Words: RENE' 95, RENE' 150, turbine components, compressor components, unidirectional solidification, tensile properties, fatigue, creep rupture, coatings
14. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P.
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Key Words: IN-100, Waspaloy, RENE' 95, Inconel 718, welding, grain size, bonding, recrystallization, temperature effect
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Rept No : R77AEG529, 56 pp., 1977 (AD-D110 864)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, fatigue, creep rupture, tensile properties, fracture surface, temperature effect
16. **MATE-Materials for Advanced Turbine Engines**
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Rept No : R77AEG647, 41 pp., 1977 (AD-D111 589)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, tensile properties, solution heat treatment
17. **Application of Hot Isostatic Pressing to Aircraft Gas Turbines**
Evans, D. J.
Plenum Press, New York, NY
Proc 6th AIRAPT Int High Pressure Conf 2, 656-63, 1977 (AD-D126 192)
Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

18. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
Mueller, J. J.
Electric Power Research Inst, Palo Alto, CA
Phase One Survey Report
Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects
19. **Manufacturing Methods for the Production of Disc Shapes by Contour Rolling**
Arnold, D. B.
General Electric Co., Aircraft Engine Group, Evendale, OH
Interim Engineering Progress Report Number Five, Apr-Jun 72
Rept No : AFML-IR-204-1(V), 22 pp., 1972 (AD-179 851L)
Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

Rene' 120

1. **Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture
2. **Hot Isostatic Pressing in the Aerospace Industry**
Price, P.E.
Metal Prog 121 (2), 46-7, 1982 (AD-D200 345)
Key Words: RENE' 120, Ti-6Al-4V, aerospace applications, mechanical properties
3. **Hipping: A Good Way to Improve Properties**
Irving, R. R.
Iron Age 224 (6), 77-81, 1981 (AD-D120 406)
Key Words: JT-9D, MERL 76, 17-4PH, RENE' 120, IN-792, IN-738, turbine components, porosity
4. **Hot Isostatic Pressing-A New Heat Treating Technology with Tremendous Potential**
Price, P.
Ind Heat 46 (6), 8-10, 1979 (AD-D115 742)
Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue
5. **Improved Properties in Castings by Hot Isostatic Pressing**
Glenn, G. M.
SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

Rene' 150

- 1. Development of Hybrid Gas Turbine Bucket Technology**
Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
General Electric Co., Gas Turbine Division, Schenectady, NY
Technical Paper
Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture
- 2. Turbine Blade Technology--Present and Future**
Allen, R. E., Sidenstick, J. E.
American Institute of Aeronautics and Astronautics, New York, NY
Proc Century 2 Aerospace Conf, American Society of Mechanical engineers, San Francisco, CA, Aug 1980
7 pp., 1981 (AD-D126 839)
Key Words: RENE' 80, RENE' 150, turbine components, aircraft structures, coatings, welding
- 3. Material for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Eighth Quarterly Engineering Report One, Dec-Feb 78
Rept No : R78AEG265, 111 pp., 1978 (AD-D112 563)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, creep properties, crack growth, notch sensitivity, tensile properties, thermal properties, oxidation, corrosion, fatigue
- 4. Materials for Advanced Turbine Engines-MATE**
Bamberger, E. N., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Ninth Quarterly Engineering Report, Mar-May 78
Rept No : R78AEG356, 20 pp., 1978 (AD-D113 124)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, coatings, microstructure, net shape forming
- 5. Material for Advanced Turbine Engines-MATE**
Arnold, D. B., Mosier, J. S., Harrison, R. W.
General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Ten, Jun-Aug 78
Rept No : R78AEG496, 56 pp., 1978 (AD-D113 898)
Key Words: RENE' 95, RENE' 150, turbine components, compressor components, unidirectional solidification, tensile properties, fatigue, creep rupture, coatings
- 6. Material for Advanced Turbine Engines-MATE**
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General Electric Co., Aircraft Engine Group, Evendale, OH
Quarterly Engineering Report Number Six, Jun-Aug 77
Rept No : R77AEG529, 56 pp., 1977 (AD-D110 864)
Key Words: RENE' 95, RENE' 150, turbine components, unidirectional solidification, fatigue, creep rupture, tensile properties, fracture surface, temperature effect

7. **MATE-Materials for Advanced Turbine Engines**
 Bamberger, E. N., Mosier, J. S., Harrison, R. W.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Seventh Quarterly Engineering Report, Sept.-Nov. 1977
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Key Words: RENE' 95, RENE' 150, turbine components, unidirectional
 solidification, tensile properties, solution heat treatment

8. **HIP of Near-Net Shapes**
 Dulis, E. J., Fleck, J. N.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
 Proc Net Shape Metalworking Program Review 369-82, 1976 (AD-D119 184L)
Key Words: PA 101, Ti-6Al-4V, net shape forming, forging

Udimet 500

1. **Repair Techniques for Gas Turbine Components**
 Liburdi, J.
 Liburdi Engineering Ltd. Burlington, Ontario, Canada
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 Rept No : AGARD-CP-398, 22-1 to 22-12, 1985 (AD-D139 985)
Key Words: Inconel X-750, Inconel 625, Udimet 500, Inconel 700, diffusion
 brazing, vacuum deposition, tensile properties, creep rupture

2. **Improvement of Material Properties of Ni-Base Alloy Investment Castings by Hot
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 Tsuji, I., Kawai, H.
 NTIS, PB84-113422, Springfield, VA
 Technical Report
 Rept No : MTB-159, 8 pp., 1983 (AD-D130 515)
Key Words: IN-738, IN-738LC, Udimet 500, Alloy 713C, turbine components,
 fatigue

3. **HIP Processing--Potentials and Applications**
 Van Der Vet, W. J.
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Key Words: Inconel X-750, Udimet 500, RENE' 100, B-1900, Nimonic 105, IN-738,
 IN-782, turbine components, fatigue, thermal cycling, creep rupture

4. **Damage Accumulation and Fracture in Creep of Nickel-Base Alloys**
 Tipler, H. R., Lindblom, Y., Davidson, J. G.
 Applied Sciences Publishers Ltd., London, UK
 Proc Conf High Temperature Alloys for Gas Turbines 359-407, 1978 (AD-D116 350)
Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500,
 Udimet 710, Udimet 720, turbine components, microstructure,
 grain boundaries, cracking, creep properties, fatigue, thermal
 fatigue, cavitation corrosion

5. Quality of Castings of Superalloys

Bachelet, E., Lesoult, G.

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High Temperature Alloys for Gas Turbines 665-99, 1978 (AD-D116 360)

Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, B1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

Udimet 700

1. A Microanalytical Study of the Early Stages of Recrystallization in the Nickel-Base Superalloy APK1

Howell, P. R., Bee, J. V.

J Mater Sci 24 (4), 1287-90, 1989 (AD-D140 953)

Key Words: APK-1, microstructure, recrystallization

2. Growth of Small Cracks in Aeroengine Disc Materials

Hudak, S. J., Jr., Davidson, D. L., Chan, K. S.

Southwest Research Institute, San Antonio, TX

Final Report

Rept No : AFWAL-TR-88-4090, 249 pp., 1988 (AD-A199 842)

Key Words: Udimet 700, Waspaloy, turbine components, fatigue, crack growth kinetics, tensile properties, temperature effect, microstructure, grain size, crack closure

3. Influence of Cyclic to Mean Load Ratio on Creep/Fatigue Crack Growth

Dimopoulos, V., Nikbin, K. M., Webster, G. A.

Metall Trans 19a (4), 873-80, 1988 (AD-D138 631)

Key Words: Nimonic AP1, oxidation, plastic deformation, fracture, creep-fatigue

4. The Effect of Temperature on Fatigue Crack Initiation from Aluminosilicate Inclusions

Woollin, P., Knott, J. F.

Ecole Nationale Supérieure des Mines de Paris, France

Proc 3rd Int Conf Fatigue and Fatigue Thresholds 2, 1087-99, 1987 (AD-D138 602)

Key Words: Nimonic AP1, fatigue crack, bend test, tensile properties

5. Effects Temperature and Hold Times on Low Cycle Fatigue of Astroloy

Choe, S. J., Stoloff, N. S., Duquette, D. J.

Pergamon Press, Elmsford, NY

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ICSMA 7-V-2, 1291-8, 1986 (AD-D139 331)

Key Words: Udimet 700, microstructure, fracture mechanics, creep-fatigue, tensile properties

6. The Role of Hot Isostatic Pressing--Now and in the Future

Widmer, R.

ASM International, Metals Park, OH

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105-16, 1986 (AD-D139 357)

Key Words: Udimet 700, Inconel 718, densification, fatigue, creep rupture

7. **Geometry Effects on Creep/Fatigue Crack Growth in a Nickel-Base Superalloy**
 Nikbin, K.M., Webster, G.A.
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 1477-90, 1986 (AD-D142 157)
Key Words: Nimonic AP1, fracture mechanics, creep-fatigue

8. **Hot Isostatic Press**
 Author Anon
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA
 A356, 142-T4

9. **The Effect of Cobalt Content in U-700 Type Alloys on Degradation of Aluminide Coatings**
 Zaplatynsky, I.
 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
 Technical Memorandum
 Rept No : NASA-TM-87173, 15 pp., 1985 (AD-D135 912)
Key Words: Udimet 700, cobalt addition, aluminide coatings, microstructure,
 crack growth

10. **Particle Surfaces and Prior Particle Boundaries in Hf Modified PM Astroloy**
 Warren, R., Ingesten, N. G., Winberg, L., Ronnhult, T.
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Key Words: Udimet 700, hafnium addition, microstructure, grain boundary
 segregation, tensile properties

11. **Problems and Possibilities for Life Extension in Gas Turbine Components**
 Koul, A. K., Wallace, W., Thamburaj, R.
 National Aeronautical Establishment, Structures and Materials Section
 Proc Propulsion and Energetics 63rd (B) Specialists' Meeting on Engine Cyclic
 Durability by Analysis and Testing, Lisse, Netherlands
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Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine
 components, damage tolerance, EDM, creep, machining

12. **Characterizations of Elevated Temperature Fatigue Crack Growth Rates**
 Crompton, J. S., Morley, S. A., Martin, J. W.
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 Proc 5th Int Symp Superalloys 1984 761-9, 1984 (AD-D132 885)
Key Words: MAR-M002, Nimonic AP1, unidirectional solidification, fatigue
 crack, stress relaxation

13. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
 Coffin, L. F.
 Plenum Press, New York, NY
 Proc 27th Sagamore Army Materials Research Conf 1-40, 1983 (AD-D131 509)
Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76,
 IN-100, NASA IIB-7, crack growth, fatigue

14. **Materials for Advanced Turbine Engine--MATE**
 Evans, D. J., Sheffler, K. D., Friedrich, L. A.
 Pratt and Whitney Aircraft Group, East Hartford, CT
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 Contract No : NAS 3-20072, 1982, 21 pp. (AD-D125 191)
Key Words: Hastelloy X, Incoloy 901, MA956, Udimet 700, MERL 76, turbine components, combustors, erosion, coatings, oxide dispersion strengthening

15. **Hipping is One Way to Check Porosity in Cast Components**
 Irving, R. R.
 Iron Age 225 (33), 43-5, 1982 (AD-D126 241)
Key Words: AA A201, AISi 4330, AA C355-T6, 142-T4, AA A356-T61, IN-738, RENE' 77, IN-792, RENE' 80, stainless steel, porosity, tensile properties, fatigue

16. **Development of Hybrid Gas Turbine Bucket Technology**
 Peterson, L. G., Hrencecin, D. E., Schilling, W. F., Ostergren, W. J.
 General Electric Co., Gas Turbine Division, Schenectady, NY
 Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

17. **Superalloy Technology-Today and Tomorrow**
 VerSnyder, F. L.
 Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 1-49, 1982 (AD-D133 988)
Key Words: MAR-M200, IN-100, Udimet 700, carbon addition, boron addition, zirconium addition, cobalt addition, turbine components, corrosion, oxidation, REP, creep rupture thermal fatigue

18. **The Relationship Between Structure, Properties, and Processing in Powder Metallurgy Superalloys**
 Davidson, J. H., Aubin, C.
 Kluwer Boston Inc., Hingham, MA
 Proc Conf High Temperature Alloys for Gas Turbines 853-86, 1982 (AD-D134 024)
Key Words: Udimet 700, Nimonic AP1, MERL 76, RENE' 95, turbine components, microstructure, crack propagation, fatigue, creep rupture, impact, thermomechanical treatment

19. **Creep-Fatigue Environment Interactions in Superalloys**
 Pelloux, R. M.
 Massachusetts Institute of Technology, Department of Materials Science and Engineering, Cambridge, MA
 Rept No : AFOSR-TR-81-0450, 35 pp., 1981 (AD-A098 790)
Key Words: Udimet 700, Waspaloy, IN-100, microstructure, creep, fatigue, embrittlement

20. **Applications of Composite Gas Turbine Components**
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 General Electric Co., Gas Turbine Division, Schenectady, NY
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 Rept No : DE82-004710, 30 pp., 1981 (AD-D125 782)
Key Words: MAR-M200, Udimet 700, IN-792, turbine components, tensile properties, creep, fatigue, diffusion bonding, unidirectional solidification

21. **Cutting Metal Loss Tied to Near Net Shapes**
Harvey, R. E.
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Key Words: RENE' 77, IN-738, IN-792, AA C355-T6, AA A356-T61, 142-T6, net shape forming, fatigue, tensile properties

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Key Words: Waspaloy, IN-100, RENE' 95, turbine components, fatigue, creep-fatigue, crack growth, porosity, fracture mechanics, tensile properties, microstructure,
3. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
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Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue
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6. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
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Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming
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technique, corrosion, erosion, fatigue, tensile properties, tungsten arc welding

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Bell, S. R.
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Koul, A. K., Wallace, W., Thamburaj, R.
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Key Words: Inconel X-750, IN-738LC, Udimet 700, IN-100, Incoloy 901, turbine
components, damage tolerance, EDM, creep, machining

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Ewing, B. A., Green, K. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc 5th Int Symp Superalloys 1984 33-42, 1984 (AD-D132 824)
Key Words: Micro cast X, IN-792, MAR-M247, AF-95, turbine components,
microstructure, tensile properties, creep rupture

20. **The Development of Preferred Orientation in Ni-Mo-Al-X and Ni-Cr-Al-X Superalloys**
Chin, H. A., Adair, A. M.
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Key Words: nickel alloys, crystal orientation, thermomechanical treatment,
alloy development

21. **Overview of Temperature and Environmental Effects on Fatigue of Structural Metals**
Coffin, L. F.
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Key Words: RENE' 95, A-286, stainless steel, Udimet 700, Waspaloy, MERL 76, IN-100, NASA IIB-7, crack growth, fatigue

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Elsner, W.
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Rept No : ASME-82-GT-94, 10 pp., 1982 (AD-D127 264)
Key Words: RENE' 80, RENE' 150, Udimet 700, MAR-M200, IN-939, RENE' 125, RENE' 120, GTD-111, IN-738, turbine components, tensile properties, unidirectional solidification, dissimilar joining, diffusion bonding, creep rupture

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Werdecker, W., Aldinger, F.
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Key Words: Inconel 601, Kanthal A-1, molybdenum, stainless steel, dissimilar joining, diffusion bonding, microhardness

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Key Words: Alloy 713LC, IN-100, MAR-M200, PWA 1480, MAR-M247, CMSX2, turbine components, rejuvenation, oxidation, vacuum melting, unidirectional solidification

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Brobst, R. P., McCarron, R. L., Beltran, A. M., Spriggs, D. R., Grzybowski, D. F.
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Key Words: FSX-414, IN-738, GTD-111, turbine components, coatings, erosion, hot corrosion

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Kidwell, J. R., Sundberg, D. V., Fujii, M.
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Key Words: Alloy 713LC, IN-792, MAR-M002, MAR-M004, IN-100, jet engines, turbine components, creep, microstructure

34. **Aircraft Gas Turbine Materials and Processes**
Kear, B. H., Thompson, E. R.
Science 208 (4446), 847-56, 1980 (AD-D126 322)
Key Words: Haynes 188, Inconel 617, HA8077, Waspaloy, B-1900, PWA 1422, Incoloy 901, IN-100, X-40, MAR-M509, Hastelloy X, turbine components, fan blades, compressor components, coatings, unidirectional solidification, superplastic forming

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 Freche, J. C., Ault, G. M.
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Key Words: AF 2-1DA, AF-115, NASA IIB-7, NASA IIB-11, MAR-M200, MA6000E, WAZ-D, WAZ20, IN-100, service life, creep rupture, tensile properties, coatings, corrosion, thermal fatigue, unidirectional solidification

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Key Words: IN-597, Nimonic 115, IN-738LC, Nimonic 80A, MAR-M200, Udimet 500, Udimet 710, Udimet 720, turbine components, microstructure, grain boundaries, cracking, creep properties, fatigue, thermal fatigue, cavitation corrosion

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Key Words: IN-738, Udimet 500, X-40, IN-100, MC-102, M3608F, C263, mto-001, P1914, B1981, M-21, FSX-430, MAR-M509, IN-939, Alloy 713LC, creep properties, fatigue, crack growth, thermal fatigue, porosity

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 Heine, H. J.
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Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, B1964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, tribaloy

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 Mishka, K. H.
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Key Words: MA956E, CAPIVAC IV, Pyromet CTX-1, Haynes 556, Haynes 8077, MA754E, MA757E, turbine components, zirconium coatings, tensile properties, creep rupture, thermal processing, thermal fatigue, oxidation, gamma prime, oxide dispersion strengthening

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 General Electric Co., Aircraft Engine Group, Evendale, OH
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Key Words: RENE' 95, Hastelloy X, AISI 304, AF 2-1DA, microstructure, hot rolling

TITANIUM AND TITANIUM ALLOYS

Titanium

1. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components
2. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
Jaffee, R. I.
Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics
3. **Flight Qualification of Titanium F-14a Airframe Components Manufactured by Hot Isostatic Pressing**
Witt, R., Magnuson, J.
Grumman Aerospace Corp., Bethpage, NY
122 pp., 1977 (AD-D305 114)
Key Words: titanium, specifications, ultrasonic testing, microporosity
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Vaughan, R. F., Blenkinsop, P. A., Morton, P. H.
Imperial Metal Industries (Kynoch) Ltd., Birmingham, UK MPR Publishing Services Ltd., Bellstone, Shrewsbury, UK
8 pp., 1976 (AD-D110 190)
Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fracture surface, titanium, CM steels, superalloys, surface layers, morphology, composition surface

Ti-6Al-2Sn-4Zr-2Mo

1. **Production of Large Titanium Investment Castings**
Ellebrecht, C., Thorne, J. K.
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Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 145-9, 1985 (AD-D135 654)
Key Words: Ti-6Al-2Sn-4Zr-2Mo, skull melting, chemical milling
2. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

3. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

4. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A.
General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

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Price, P.
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Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue

6. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Ti-6Al-2Sn-4Zr-6Mo

1. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

2. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

3. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A.
General Motors Corp., Detroit Diesel Allison Division
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Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

4. **All Systems Are Go for Powder Metallurgy**
 Irving, R. R.
 Iron Age 223 (28), 41-5, 1980 (AD-D118 875)
Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

5. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A.
 SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Ti-6Al-4V

1. **Effects of Treatments on Mechanical Properties of Titanium Alloy Castings**
 Eylon, D., Froes, F. H., Barice, W. J.
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Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue, net shape

2. **Titanium NNS Technology Shaping Up**
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Key Words: Ti-6Al-4V, turbine components, near net shape, rapid solidification

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 Partridge, P. G., McDermid, D. S., Bottomley, I., Common, D.
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Key Words: Ti-6Al-4V, AA 7475, Supral 100, Supral 150, Supral 220, alclad coatings, microstructure, grain size, aging, elastic properties, fatigue, fracture toughness

4. **Titanium Near Net Shape Components for Demanding Airframe Applications**
 Witt, R. H., Ferreri, A. L.
 SAMPE Qtrly 17 (3), 55-62, 1986 (AD-D135 849)
Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties

5. **Microstructure Modification of Ti-6Al-4V castings**
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Key Words: Ti-6Al-4V, turbine components, crack growth, forging, fatigue

7. **Metallurgical Advancements in Investment Casting Technology**
Dardi, L. E., Dalal, R. P., Yaker, C.
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Key Words: MAR-M247, Ni-7Al-14Mo, Ti-6Al-4V, turbine components, fatigue properties, unidirectional solidification

8. **Cast HIP and Heat Treated Titanium UH-60A Main Rotor Damper Bracket**
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Key Words: Ti-6Al-4V, UH-60A Black Hawk, casting, arc melting, fatigue, tensile properties

9. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4

10. **Comparison of Various Fabrication Methods for the Production of an Aircraft Structural Component from Titanium Semifabricates (II)**
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Key Words: Ti-6Al-4V, aircraft structures, tensile properties, hammer forging, electron beam welding

11. **Comparison of Various Fabrication Methods for the Production of an Aircraft Structural Component from Titanium Semifabricates (I)**
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Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, forging, extrusion, fatigue, tensile properties

12. **Effect of Hot Isostatic Pressing and Heat Treatment on Fatigue Properties of Ti-6Al-4V Castings**
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13. **Nontraditional Thermal Processing of HIP'ed Investment Cast Ti-6Al-4V Alloy**
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Key Words: Ti-6Al-4V, tensile properties, fatigue stress, hydrogenation

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Key Words: Ti-6Al-4V, microstructure, tensile properties, fatigue stress, Charpy impact, sand casting

17. **Thermo-Chemical Treatment (TCT) of Titanium Alloy Net Shapes**
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Key Words: Ti-6Al-4V, REP, tensile strength, fatigue stress, net shape forming

18. **Titanium Casting--A Review**
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Key Words: Ti-6Al-4V, repair welding, microstructure, fatigue crack

19. **Investment Casting of Large Components**
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Key Words: Ti-6Al-4V, tensile properties, heat treatment

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Key Words: Ti-6Al-4V, microstructure, fatigue, Charpy impact, tensile properties

21. **Status of Titanium Net-Shape Technology**
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Key Words: Ti-6Al-4V, isothermal forging, net shape, tensile properties, fracture toughness

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Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

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Key Words: Ti-6Al-4V, stainless steel, aluminum alloys, porosity, rejuvenation, cost

24. **Large Structural Titanium Castings**
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Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

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Key Words: Ti-6Al-4V, welding, crack growth, tensile properties, hardness, fatigue

26. **Recent Advancement in Titanium Near-Net Shape Technology**
 Chen, C. C.
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Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, net shape forming, cost

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Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

28. **Fatigue Evaluation of the Molded T.A6V Alloy Isostatically Compacted Under Heat. Summary of Test #M9 505600**
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Key Words: Ti-6Al-4V, fatigue, molding, mechanical properties

29. **Fatigue Testing of CIC-Densified Cast T.A6V**
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Key Words: Ti-6Al-4V, microstructure, densification, fatigue

30. **Hot Isostatic Pressing in the Aerospace Industry**
 Price, P.E.
 Metal Prog 121 (2), 46-7, 1982 (AD-D200 345)
Key Words: RENE' 120, Ti-6Al-4V, aerospace applications, mechanical properties

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 Hammer, A. N.
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 Rept No : RDR-1827-18-VOL-1, 84 pp., 1981 (AD-A111 431)
Key Words: Ti-6Al-4V, turbine components, fatigue, welding, tensile properties, notch strength, stress corrosion

32. **Manufacture of Cost-Affordable High Performance Titanium Components for Advanced Air Force Systems**
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Key Words: Ti-6Al-4V, tensile properties, fatigue, net shape forming, superplastic forming

33. **Mechanical Properties of Titanium Castings**
 Ulitchny, M. G.
 Bendix Corp., Kansas, MO
 Rept No : BDX-613-2680, 11 pp., 1981 (AD-D124 358)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, fracture toughness, aging, tensile properties

34. **Energy Efficient Engine. Volume 2. Appendix A: Component Development and Integration Program**
 Moracz, D. J., Cook, C. R.
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Key Words: Ti-6Al-4V, IN-100, seam welding, microstructure, diffusion bonding

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Key Words: Ti-6Al-4V, microstructure, fatigue, creep

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Key Words: AISI 4600, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Waspaloy, IN-100, AISI 329, 12Cr steel, injection molding, cost, applications

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Key Words: Ti-6Al-4V, fatigue, net shape forming, diffusion bonding

38. **Creep Behavior of Cast Ti-6Al-4V Alloy**
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Key Words: Ti-6Al-4V, grain size, creep, tensile properties, plastic deformation

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Key Words: Ti-6Al-4V, fatigue, surface roughness, microhardness

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Key Words: Ti-6Al-4V, diffusion bonding, creep, near net shape forming, notch properties, tensile properties, fatigue

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Key Words: Ti-6Al-4V, defects, impact toughness, fatigue, bearings

43. **Built-Up Low-Cost Advanced Titanium Structures--BLATS**
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 Quarterly Progress Report Number Five, Oct 78-Jan 79
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Key Words: Ti-6Al-4V, diffusion bonding, tensile properties, welding, compression tests, fatigue

44. **Hot Isostatic Pressing Rejuvenation of Disks**
 Sundberg, D. V., Comey, D. H.
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 Rept No : 21-3238, 139 pp., 1979 (AD-A078 593)
Key Words: Ti-6Al-4V, Waspaloy, turbine components, rejuvenation, tensile properties

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Key Words: Ti-6Al-4V, RENE' 120, Ti-6Al-2Sn-4Zr-2Mo, microstructure, fatigue
46. **Fatigue Crack Initiation in Hot Isostatically Pressed Ti-6Al-4V Castings**
Eylon, D.
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Key Words: Ti-6Al-4V, microstructure, grain boundaries, fractography, fatigue, crack growth
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Paez, C.
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Key Words: Ti-6Al-4V, turbine components, buckling strength, tensile properties, fatigue, superplastic forming, creep rupture, welding, shear stress
48. **Advanced Manufacturing Methods for High Quality Low Cost Titanium Powder Production**
Peebles, R. E.
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Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding
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Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
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Contract No : N00014-78-M-0074
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Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection
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Bittence, J. C.
Mater Eng 88 (4), 54-7, 1978 (AD-D113 844)
Key Words: Inconel 718, IN-792, Ti-6Al-4V, 17-4PH, AA A357, porosity, fatigue, creep properties, deformation, cost
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Heine, H. J.
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Key Words: Ti-6Al-4V, 18/8 stainless, 18Cr-10Ni, AA A360, B1914, B1925, B1964, B1981, airframes, aircraft structures, creep rupture, stress analysis, nondestructive testing, tensile properties, tribaloy
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Jaffec, R. I.
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Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement, fracture mechanics

53. **Repair of Titanium Airframe Castings by Hot Isostatic Pressing**
 Magnuson, J.
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Key Words: Ti-6Al-4V, porosity, microstructure, defects, voids, metallography

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 Freeman, W. R., Jr.
 Metal Prog 112 (3), 33-8, 1977 (AD-D110 513)
Key Words: B-1900, IN-792, Ti-6Al-4V, IN-100, tensile properties turbine components, fatigue, creep rupture

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 Evans, D. J.
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Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile properties, creep rupture, net shape forming

56. **HCF Crack Initiation Analysis of Ti-6Al-4V Cast and HIP Specimens**
 Eylon, D.
 Manufacturing Technology Division, AFML, Wright-Patterson AFB, OH
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Key Words: Ti-6Al-4V, fracture surface, crack propagation, microstructure, fatigue stress, grain boundaries

57. **HIP of Near-Net Shapes**
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Key Words: PA 101, Ti-6Al-4V, net shape forming, forging

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Key Words: Inconel 718, Ti-6Al-4V, 17-4PH, AA A357, tensile properties, nondestructive testing

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 SAMPE Qtrly 8 (1), 1-9, 1976 (AD-D107 893)
Key Words: IN-738, RENE' 80, RENE' 120, RENE' 77, Ti-6Al-4V, AA A356, AA C355 porosity, tensile properties, microstructure, creep rupture, density, fatigue

60. **Comparative Evaluation of Forged Ti-6Al-4V Bar made from Shot Produced by the REP and CSC Processes**
 Vaughan, R. F., Blenkinsop, P. A., Morton, P. H.
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 8 pp., 1976 (AD-D110 190)
Key Words: Ti-6Al-4V, tensile properties, fracture toughness, fracture surface, titanium, CM steels, superalloys, surface layers, morphology, composition surface

61. **Materials and Processing Technology for Advanced Gas Turbines**
 Hauser, H. A.
 SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

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 Nagan, R. M.
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Key Words: 17-4PH, Hastelloy X, Inconel 718, Ti-6Al-4V, aircraft structures, turbine components, tensile properties

63. **Improvement of Nuclear Reactor Component Materials by Application of Hot Isostatic Processing (HIP)**
 Mueller, J. J.
 Electric Power Research Inst, Palo Alto, CA
 Phase One Survey Report
 Rept No : EPRI-500-1, PB-250952, 64 pp., 1975 (AD-D107 180)
Key Words: Ti-6Al-4V, AA A356-T61, RENE' 95, IN-738, IN-792, RENE' 77, RENE' 80, nuclear reactor, turbine components, tensile properties, fatigue, creep rupture, cladding, defects

64. **Manufacturing of Titanium Airframe Components**
 Witt, R., Magnuson, J.
 Grumman Aerospace Corp., Bethpage, NY
 Final Report, Apr 74-Apr 75
 Contract No : N00019-74-C-0301
 90 pp., 1975 (AD-D301 610)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, net shape, fracture toughness

65. **Titanium Powder Metallurgy**
 Sutcliffe, P. W., Mardon, P. G.
 AGARD Structures and Materials Panel, 17 pp., 1974 (AD-D102 697)
Key Words: Ti-6Al-4V, tensile properties, density, cost

Ti-6Al-6V-2Sn

1. **Comparison of Various Fabrication Methods for the Production of an Aircraft Structural Component from Titanium Semifabricates (I)**
 Mietrach, D., Blomeier, K.
 Aluminum English 61 (2), E83-8, 1985 (AD-D132 335)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, forging, extrusion, fatigue, tensile properties

2. **Developments in Titanium Alloy Casting Technology**
 Eylon, D., Froes, F. H., Gardiner, R. W.
 J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

3. **Mechanical Properties of Titanium Castings**
Ulitchny, M. G., Bendix Corp., Kansas, MO
Rept No : BDX-613-2680, 11 pp., 1981 (AD-D124 358)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, fracture toughness, aging, tensile properties
4. **Engineering Design, Development, Fabrication and Testing Services Related to 155-mm, XM785 Nuclear Projectile**
Steiner, E. G., Ballheim, R. W., Brinker, G. G.
Chamberlain Mfg. Corp., Research and Development Division, Waterloo, IA
Rept No : C8182-PR-026, 452 pp., 1980 (AD-B052 420L)
Key Words: Ti-6Al-6V-2Sn, projectiles, ballistic tests, spin test
5. **Manufacturing of Titanium Airframe Components**
Witt, R., Magnuson, J.
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Contract No : N00019-74-C-0301, 90 pp., 1975 (AD-D301 610)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, net shape, fracture toughness

Transage 175

1. **Titanium Near Net Shape Components for Demanding Airframe Applications**
Witt, R. H., Ferreri, A. L.
SAMPE Qtrly 17 (3), 55-62, 1986 (AD-D135 849)
Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties
2. **Data Sheet: Transage 175 (Ti-2.7Al-13V-7Sn-2Zr) High-Strength Cast Alloy**
Crossley, F. A.
The Metallurgical Society of AIME, Warrendale, PA
Proc Symp Beta Titanium Alloys in the 1980's 493-6, 1984 (AD-D136 674)
Key Words: Transage 175, thermal stability, density, tensile properties
3. **Cast Transage 175 Titanium Alloy for Durability Critical Structural Components**
Crossley, F. A., Barice, W. J.
J Aircr 20 (1), 66-9, 1983 (AD-D126 651)
Key Words: Transage 175, tensile properties, notch sensitivity, fatigue
4. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth
5. **Large Structural Titanium Castings**
Barice, W. J.
J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

6. **Cast Titanium Components for Rotating Gas Turbine Applications**
Ewing, B. A., General Motors Corp., Detroit Diesel Allison Division
Proc 54th Meeting of the AGARD Structures and Materials Panel
13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo,
Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net
shape forming, Charpy impact, tensile properties, fatigue,
cost

7. **Influence of Hot Isostatic Processing and Heat Treatment Variables on the Tensile Properties of Cast Transage 175 Alloy, Ti-2.5Al-13V-7Sn-2Zr**
Crossley, F. A., Barice, W. J., SAMPE, Azusa, CA
Proc 27th National SAMPE Symp and Exhibition 667-78, 1982 (AD-D127 142)
Key Words: Transage 175, Ti-2.5Al-13V-7Sn-2Zr, heat treatment, age hardening,
tensile properties

8. **Mechanical Properties of Two Cast and Hot Isostatically Processed Martensitic Transage Titanium Alloys**
Crossley, F. A., Barice, W. J.
J Met 33 (2), 26-32, 1981 (AD-D120 560)
Key Words: Transage 129, Ti-2Al-11V-2Sn-11Zr, Transage 134, Transage 175,
tensile properties, fatigue, density

Miscellaneous Titanium Alloys

1. **Cast Beta-Titanium Alloy Ready for Flight**
McKenzie, R.M.
Adv Mater Processes 136 (1), 45-6, 1989 (AD-D143 200)
Key Words: Ti-15V-3Cr-3Al-3Sn, cyclic aging, tensile properties

2. **Alloy Development, Processing and Characterization of Devitrified Titanium Base Microcrystalline Alloys**
Whang, Sung H.
Barnett Institute of Chemical Analysis and Materials Science, Northeastern
University, Boston, MA
Annual Report, Contract No : N00014-82-K-0579, 17 pp., 1986 (AD-A172 140)
Key Words: titanium alloys, aluminum addition, tin addition yttrium addition,
lanthanum addition, thorium addition, erbium addition,
microscopy, age hardening, melt spinning, tensile properties

3. **Deformation of Rapidly Solidified Ti-2Er**
Kampe, S. L., Koss, D. A.
Department of Materials Science and Engineering, Pennsylvania State University,
University Park, PA
Technical Report Number Three
Contract No : N00014-86-K-0381, 8 pp., 1986 (AD-A173 734)
Key Words: Ti-2Er, grain size, strain rate, flow stress, vacuum annealing

4. **Structure-Property Relationships in Centrifugally Cast IMI 550**
Kearns, M. W., Ward-Close, C. M.
SAMPE J 22 (1), 7-11, 1986 (AD-D134 747)
Key Words: IMI 550, tensile properties, fracture toughness, creep, aging

5. **Titanium Near Net Shape Components for Demanding Airframe Applications**
Witt, R. H., Ferreri, A. L.
SAMPE Qtrly 17 (3), 55-62, 1986 (AD-D135 849)
Key Words: Ti-6Al-4V, Transage 175, Transage 134, fracture toughness, tensile properties

6. **Manufacturing Process for the Hot Isostatic Pressing of Large Titanium PM (Powder Metallurgy) Shapes**
Petersen, V. C., Chandhok, V. K., Moll, J. H.
Colt Industries Inc., Crucible Materials Research Center, Pittsburgh, PA
Rept No : AFWAL-TR-85-4120, 474 pp., 1985 (AD-B101 439L)
Key Words: titanium alloys, crack propagation, fracture, weldability, toughness, machinability

7. **Titanium Mill Production**
Belov, A. F.
Deutsche Gesellschaft Metallk, Germany
Proc 5th Int Conf Titanium, Titanium--Science and Technology
1, 31-8, 1985 (AD-D135 651)
Key Words: VT5L, tensile properties, fatigue, heat treatment

8. **Alloy Development, Processing and Characterization of Devitrified Titanium Based Microcrystalline Alloys**
Whang, S. H.
Barnett Institute of Chemical Analysis and Materials Science, Northeastern University, Boston, MA
Annual Report, Contract No : N00014-82-K-0597, 113 pp., 1984 (AD-A149 609)
Key Words: Ti-5Sn-3Y, Ti-5Sn-4.5La, Ti-8Mo-2.5Al-1.5B, Ti-6Al-4V-2Si, Ti-2.5Al-5.5Er, Ti-5Al-2Si, Ti-18Zr-4.5Si, Ti(5)Si(3), Al(3)La, Ti-5Al-2.5Sn-3Ce, Ti-5Al-2.5Sn-1B, Ti-5Al-2.5Sn-2Y, Ti-5Al-2.5Sn, Ti-6.5Si, Ti-5Al-4Zr-2.5Sn-3La, Ti-8Zr-3.5Al-3.5Si, rapid solidification, hardness, rare earth solubility

9. **Emerging Trends in Aerospace Materials and Processes**
Chandler, H. E.
Metal Prog 125 (5), 21-9, 1984 (AD-D130 023)
Key Words: Ti-10V-2Fe-3Al, Ti-15V-3Cr-3Al-3Sn, steel, aircraft, net shape forming, manufacturing

10. **Thermal Treatment of Titanium Alloy TA6Zr5D Obtained by Powder Metallurgy**
Quesne, C., Severac, C., Servant, C.
NTIS, PB86-159415, Springfield, VA
Technical Translation
Rept No : PB86-159415, 55 pp., 1984 (AD-D140 123)
Key Words: IMI 685, microstructure, porosity, precipitation, tensile properties

11. **Developments in Titanium Alloy Casting Technology**
Eylon, D., Froes, F. H., Gardiner, R. W.
J Met 35 (2), 35-47, 1983 (AD-D126 785)
Key Words: Ti-6Al-4V, Ti-6Al-6V-2Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-5Al-2.5Sn, Transage 175, Beta III, Ti-10V-2Fe-3Al, microstructure, net shape forming, welding, tensile properties, fracture toughness, fatigue, crack growth

12. **Development and Demonstration of Economic Production Systems in Airframe Construction. Part 2: Technological Phase. Part 6: Review**
 NTIS, N84-23555, Springfield, VA
 Rept No : N84-23555, 152 pp., 1983 (AD-D134 719)
Key Words: AA A357, titanium alloys, fracture mechanics, diffusion bonding, fatigue

13. **Treatment Processes of Light and Heat Resistant Alloys**
 Belov, A. F., Tselikov, A. I., Trishkin, V. G., Rakovskiy, V. S., Rykalin, N. N.
 Foreign Technology Division, Wright-Patterson AFB, OH
 Rept No : FTD-ID(RS)T-0412-82, 335 pp., 1982 (AD-B070 680L)
Key Words: aluminum alloys, titanium alloys, mechanical properties, fatigue, cracking

14. **Large Structural Titanium Castings**
 Barice, W. J.
 J Aircr 19 (8), 687-91, 1982 (AD-D125 528)
Key Words: titanium, Ti-6Al-4V, Ti-5Al-2.5Sn, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Transage 175, turbine components

15. **Recent Advancement in Titanium Near-Net Shape Technology**
 Chen, C. C.
 J Met 34 (11), 30-5, 1982 (AD-D126 098)
Key Words: Ti-6Al-4V, Ti-10V-2Fe-3Al, net shape forming, cost

16. **Cast Titanium Components for Rotating Gas Turbine Applications**
 Ewing, B. A.
 General Motors Corp., Detroit Diesel Allison Division
 Proc 54th Meeting of the AGARD Structures and Materials Panel
 13-1 to 13-14, 1982 (AD-D127 041)
Key Words: Ti-6Al-4V, Ti-6Al-2Sn-2Zr-2Mo-2Cr, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Transage 175, turbine components, net shape forming, Charpy impact, tensile properties, fatigue, cost

17. **Influence of Hot Isostatic Processing and Heat Treatment Variables on the Tensile Properties of Cast Transage 175 Alloy, Ti-2.5Al-13V-7Sn-2Zr**
 Crossley, F. A., Barice, W. J.
 SAMPE, Azusa, CA
 Proc 27th National SAMPE Symp and Exhibition 667-78, 1982 (AD-D127 142)
Key Words: Transage 175, Ti-2.5Al-13V-7Sn-2Zr, heat treatment, age hardening, tensile properties

18. **Mechanical Properties of Two Cast and Hot Isostatically Processed Martensitic Transage Titanium Alloys**
 Crossley, F. A., Barice, W. J., J Met 33 (2), 26-32, 1981 (AD-D120 560)
Key Words: Transage 129, Ti-2Al-11V-2Sn-11Zr, Transage 134, Transage 175, tensile properties, fatigue, density

19. **Advanced Manufacturing Methods for High Quality Low Cost Titanium Powder Production**
 Peebles, R. E.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Rept No : AFML-IR-189-7T(4), 59 pp., 1978 (AD-D114 365L)
Key Words: Ti-6Al-4V, Ti-5Al-2Sn-2Zr-4Cr-4Mo, isothermal process, forging, hydriding

- 20. Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys**
Ruckle, D. L., Blackburn, M. J., Hayden, S. Z.
Pratt and Whitney Aircraft Group, East Hartford, CT
Fourth Quarterly Report Nov 75-Feb 76
Rept No : EII-75-200-4001-3, 46 pp., 1976 (AD-D108 056L)
Key Words: Ti-16Al-10Nb, TiAl, turbine components, fatigue, bend test, ECG, EDM, creep, Charpy impact, creep rupture, notch properties, tensile properties
- 21. Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

INTERMETALLIC COMPOUNDS

TiAl

- 1. Flow Softening and Microstructure Evolution during Hot Working of Wrought Near-Gamma Titanium Aluminides**
Semiatin, S. L., Frey, N., El-Soudani, S. M., Bryant, J. D.
Metall Trans A 23A, 1719-35, 1992
Key Words: TiAl, Ti-48 at pct Al-2.5 at pct Nb, Ti-48 at pct Al-2 at pct Nb-2 at pct Cr, isothermal forging, hot compression test
- 2. Design, Manufacture, and Evaluation of Titanium Aluminide Components**
O'Connell, T. E., Blackburn, M. J., Smith, M. P.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Interim Report Feb-Apr 84
Rept No : FR-18287, 45 pp., 1984 (AD-D130 536L)
Key Words: TiAl, turbine components, extrusion, ring rolling, tensile properties, solution heat treatment
- 3. R&D on Composition and Processing of Titanium Aluminide Alloys for Turbine Engines**
Blackburn, M. J., Smith, M. P.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Rept No : PWA-FR-16259, 103 pp., 1982 (AD-B069 620)
Key Words: TiAl, Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-48 at pct Al-1 at pct V, turbine components, aluminides, microstructure, modulus, tensile properties, creep rupture, Charpy impact, fatigue, fracture toughness, thermal properties
- 4. Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys**
Ruckle, D. L., Blackburn, M. J., Hayden, S. Z.
Pratt and Whitney Aircraft Group, East Hartford, CT
Rept No : EII-75-200-4001-3, 46 pp., 1976 (AD-D108 056L)
Key Words: Ti-16Al-10Nb, TiAl, turbine components, fatigue, bend test, ECG, EDM, creep, Charpy impact, creep rupture, notch properties, tensile properties
- 5. Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A., SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo, Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900, MAR-M200, turbine components, fracture mechanics, fatigue, creep rupture

Miscellaneous Intermetallic Compounds

- 1. Flow Softening and Microstructure Evolution during Hot Working of Wrought TNear-Gamma Titanium Aluminides**
Semiatin, S. L., Frey, N., El-Soudani, S. M., Bryant, J. D.
Metall Trans A 23A, 1719-35, 1992
Key Words: TiAl, Ti-48 at pct Al-2.5 at pct Nb, Ti-48 at pct Al-2 at pct Nb-2 at pct Cr, isothermal forging, hot compression test

2. **Mechanical Properties of Fe-Modified L1(2)-Type Al₃Ti**
Inoue, H. R. P., Cooper, C. V., Favrow, L. H., Hamada, Y., Wayman, C. M.
Materials Research Society, Pittsburgh, PA
Proc Symp Mater Res Soc 213, 493-8, 1991 (AD-D145 311)
Key Words: Al(3)Ti, Al-25 at pct Ti-7.5 at pct Fe, microstructure,
dislocation structure, compressive properties, fracture
surface, intergranular fracture, brittle fracture

3. **Fatigue and Fracture of Intermetallic Alloys**
Cooper, C. V., Inoue, H. E., Giamei, A. F., Favrow, L. H.
United Technologies Research Center, East Hartford, CT
Annual Report
Rept No : R91-917992-2, 47 pp., 1991 (AD-A238 686)
Key Words: Al(3)Ti, turbine components, iron addition, copper addition,
nickel addition, phase transformation, microstructure, fatigue, fracture

4. **Elastic Modulus of NiAl-TiB(2) Composites in the Temperature Range 300 to 1273 K**
Viswanadham, R. K., Mannan, S. K., Kumar, K. S.
J Mater Sci Lett 8 (4), 409-10, 1989 (AD-D140 949)
Key Words: NiAl, boride addition, modulus of elasticity

5. **The Effect of 0.1 Atomic Percent Zirconium on the Cyclic Oxidation Behavior of Beta-NiAl for 3000 Hours at 1200 C**
Barrett, C. A.
National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH
Technical Memorandum
Rept No : NASA-TM-101408, 18 pp., 1989 (AD-D141 688)
Key Words: NiAl, zirconium addition, microstructure, spalling, cyclic test,
oxidation, long term tests

6. **Investigation of As-Cast and Rapidly Solidified Al(3)Sc**
Tarnacki, J., Kim, Y.W.
Scr Metall 23 (7), 1063-8, 1989 (AD-D142 932)
Key Words: Al(3)Sc, microscopy, melt spinning, hardness, compressive
properties

7. **Environmental Effects in Niobium Base Alloys and other Selected Intermetallic Compounds**
Meier, G. H., Thompson, A. W.
Department of Materials Science and Engineering, Pittsburgh University, PA
Annual Report Number One
Rept No : AFOSR-TR-89-0366, 68 pp., 1988 (AD-A206 072)
Key Words: NbAl(3), Nb-21Ti-10Al-15Si, Ti-24Al-11Nb, Nb-21Ti-25Si,
Nb-25Ti-12.5Al-25Si, Nb-25Ti-12.5Ta-12.5Al-25Si, turbine
components, tensile properties, fracture toughness, crack
growth

8. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid
solidification, injection molding

9. **R&D on Composition and Processing of Titanium Aluminide Alloys for Turbine Engines**
Blackburn, M. J., Smith, M. P.
Pratt and Whitney Aircraft Group, Government Products Div, West Palm Beach, FL
Interim Report
Rept No : PWA-FR-16259, 103 pp., 1982 (AD-B069 620)
Key Words: TiAl, Ti(3)Al, Ti-25Al-10Nb-3V-1Mo, Ti-48 at pct Al-1 at pct V,
turbine components, aluminides, microstructure, modulus,
tensile properties, creep rupture, Charpy impact, fatigue,
fracture toughness, thermal properties
10. **Rolling, Forming and Joining Titanium-Aluminide Sheet**
Bhatt, D. D., Meyer, G. E., Hoffmann, A. L.
Battelle Memorial Institute, Columbus, OH
Final Report
Rept No : AFML-TR-78-59, 130 pp., 1978 (AD-B031 214)
Key Words: Ti-16Al-10Nb, Ti-12Al-19Nb, Ti-13Al-20Nb, Ti-36Al-5Nb,
Ti-32Al-5Nb-5W, rolling, superplastic forming, joining,
tensile properties, hardness, fatigue, creep test, bend test
11. **Materials and Processing Technology for Advanced Gas Turbines**
Hauser, H. A.
SAMPE Qtrly 6 (3), 8 pp., 1975 (AD-D101 035)
Key Words: TiAl, Ti(3)Al, Ti-6Al-4V, Ti-6Al-2Sn-4Zr-6Mo, Ti-6Al-2Sn-4Zr-2Mo,
Ti-8Al-1Mo-1V, IN-100, IN-738, IN-792, Alloy 713, B-1900,
MAR-M200, turbine components, fracture mechanics, fatigue,
creep rupture

REFRACTORY METALS AND ALLOYS

1. **The Joining of Refractory Metals by Hot Isostatic Pressing**
Werdecker, W., Aldinger, F.
High Temp-High Pressures 14 (2), 183-97, 1982 (AD-D127 724)
Key Words: Inconel 601, Kanthal A-1, molybdenum, stainless steel, dissimilar joining, diffusion bonding, microhardness
2. **Processing: The Rediscovered Dimension in High Temperature Alloys**
Semchyshen, M.
Standardization News 4 (4), 9-19, 1976 (AD-D110 676)
Key Words: Inconel 718, RENE' 80, AISI 4140, Udimet 700, TZM, IN-738, Waspaloy, remelting, alloying, creep rupture
3. **Processing and Characterization of Several Tungsten Alloys**
Hall, R. C., Ossin, A., Ammon, R. L., Buckman, R. W., Aronin, J.
Proc 20th National SAMPE Symp and Exhibition, 13 pp., 1975 (AD-D107 039)
Key Words: W-10Cu, W-2ThO₂, W-4Re, W-0.5HfC, turbine components, leading edges, microstructure, tensile properties, thermal properties
4. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part I**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-74-005, 248 pp., 1974 (AD-D100 645)
Key Words: tantalum, niobium, tungsten, T-111, rhenium, dissimilar joining, electron beam welding, pressure bonding, interdiffusion, voids, aging, mathematical model, niobium alloys
5. **Interdiffusion Behavior of Tungsten or Rhenium and Group V and VI Elements and Alloys of the Periodic Table-Part II (Appendices)**
Arcella, F. G.
Westinghouse Astronuclear Lab, Pittsburgh, PA
Final Report
Rept No : WANL-M-FR-74-005, 147 pp., 1974 (AD-D100 713)
Key Words: Nb-1Zr, W-30Re-20Mo, Mo-50Re, T-111, Ta-10W, niobium, tungsten, tantalum, porosity, dissimilar joining, weldability, fracture mechanics, cracking, degradation, diffusivity, interdiffusion

MISCELLANEOUS CAST ALLOYS

1. **Manufacture of Reference Defects for NDE through Hot Isostatic Pressing**
Sinclair, A.N., Graf, M., Moles, M.C., Doleby, M., DaSilva, V.
Review of Progress in Quantitative Nondestructive Evaluation
10B, 2235-42, 1991 (AD-D331 425)
Key Words: Zircaloy, Zr-2.5Nb, pressure tube, fabricated defects
2. **Progress of Powder Metallurgy in North America**
Roll, K.H., Johnson, P.K.
Int J Powder Metall Powder Technol 20 (3), 185-92, 1984 (AD-D200 698)
Key Words: copper, iron, Inconel 625, AISI 316L, M-2, NiFe, rapid
solidification, injection molding
3. **A Retrospective View of Metallurgy During the 25 Years of the Gillett Lectures**
Jaffee, R. I.
Standardization News 5 (1), 9-22, 1977 (AD-D108 834)
Key Words: AISI 316, Ti-6Al-4V, titanium, zirconium, hafnium, embrittlement,
fracture mechanics
4. **Hot Isostatic Pressure Healing of Navy Gun Metal Castings**
Seifert, D. A., Hanes, H. D.
Battelle Memorial Institute, Columbus, OH
Final Report
Contract No : N00024-73-C-5375
41 pp., 1974 (AD-787 598)
Key Words: copper alloy 903, gun metal, microstructure, porosity, defects,
tensile properties

3. Miscellaneous

ALUMINUM ALLOYS

1. **Applications of Coating Technology and HIP to Advanced Materials Processing**
Nicholls, J. R., Stephenson, D. J.
Mater High Temp 9 (2), 110-20, 1991
Key Words: nickel, copper, phosphor bronze, Ni-13Al, MAR-M002, AA 7075, AA 8090, silver, Inconel 625, ion plating, electron beam evaporation, coatings, microstructure, creep, diffusion bonding
2. **The Influence of Specimen Geometry on Near Threshold Fatigue Crack Growth**
Vecchio, R. S., Crompton, J. S., Hertzberg, R. W.
Fatigue Fract Eng Mater Struct 10 (4), 333-42, 1987 (AD-D137 808)
Key Words: Udimet 700, AA 2024-T3, grain size, crack growth, fatigue crack
3. **Hot Isostatic Press**
Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4
4. **Dual-Property T63 Turbine Rotor**
Ewing, B. A., Jain, S. K.
General Motors Corp., Allison Gas Turbine Operations, Indianapolis, IN
Final Report Mar 81-Apr 84
Rept No : USAAVSCOM-TR-84-D-18, 166 pp., 1984 (AD-B089 072L)
Key Words: nickel alloys, aluminum alloys, steels, T63 turbine components, defects, fatigue, fabrication, cracking, fracture, ultrasonic testing, stress analysis
5. **Metallforming's Big Push to Systems Technologies**
Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCerf, B. H.
Iron Age 222 (43), 53-63, 1979 (AD-D116 917)
Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding
6. **Research to Conduct an Exploratory Experimental and Analytical Investigation of Alloys**
Ruckle, D. L.
Pratt and Whitney Aircraft Group, East Hartford, CT
Third Quarterly Report, Aug-Nov 75
Rept No : EII-75-200-4001-2, 55 pp., 1975 (AD-D108 084L)
Key Words: Ti-16Al-10Nb, aluminum alloys, turbine components, microstructure, thermal properties, fracture, hardness, fatigue, tensile properties, creep rupture, notch properties

IRON ALLOYS

Miscellaneous Stainless Steels

1. **Superplasticity and Hardening of Extremely Fine Grained Ultrahigh Carbon-Chromium-Vanadium-Iron Alloys**
Frommeyer, G.
Pergamon Press, Elmsford, NY
Proc 7th Int Conf Strength of Metals and Alloys
ICSMA 7-V-2, 877-84, 1986 (AD-D139 304)
Key Words: 5Cr steel, 18Cr stainless, forging, atomization, tensile properties, rapid solidification
2. **Application of Diffusion Welding in the USA**
Weld J 60 (2), 22-33, 1981 (AD-D120 554)
Owczarski, W. A. Paulonis, D. F.
Key Words: Pyromet X-15, T-111, Ti-6Al-4V, diffusion welding, bonding, dissimilar joining
3. **An Investigation of Diffusion Bonding of Titanium to Stainless Steel**
Chen, C. C.
Metallurgical Society of AIME, Warrendale, PA
Proc 4th Int Conf Titanium, Titanium'80-Science and Technology
4, 2379-88, 1980 (AD-D121 360)
Key Words: titanium, AISI 304, dissimilar joining, diffusion bonding, microhardness
4. **Ultrasonic Inspectability Improvement of Austenitic Stainless Steel Welds After Thermal Mechanical Processing**
Malif, R.K., Lott, L.A.
NDT for Energy Progress 66-70, 1980 (AD-D310 104)
Key Words: stainless steel, welds, microstructure, mechanical properties
5. **Metalforming's Big Push to Systems Technologies**
Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCerc, B. H.
Iron Age 222 (43), 53-63, 1979 (AD-D116 917)
Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding
6. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
Herman, H.
State University of New York at Stony Brook, Department of Materials Sciences, NY
Final Report
Contract No : N00014-78-M-0074
58 pp., 1978 (AD-A061 867)
Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack detection

7. **Technological Considerations in the Forging of Superalloy Rotor Parts**
 Wilkinson, N. A.
 Met Technol 4 (7), 346-59, 1977 (AD-D110 651)
Key Words: Waspaloy, Udimet 700, Inconel 718, A-286, grain size, grain boundaries, thermomechanical treatment, notch sensitivity, tensile properties, creep properties, fatigue size, Charpy impact, dislocation structure

8. **Compositional and Structural Aspects of Processing Nickel-Base Alloys**
 Knott, A. R., Symonds, C. H.
 Met Technol 3 (8), 370-9, 1976 (AD-D103 973)
Key Words: Monel 400, Nimonic 75, Nimonic 80A, Nimonic 90, Nimonic 105, Nimonic 115, Nimonic PE13, Inconel 600, Inconel 718, Incoloy 800, Incoloy 825, microstructure, deformation, segregation, grain size

9. **Materials Research for Superconducting Machinery-IV**
 Reed, R. P., Clark, A. F., Van Reuth, E. C.
 National Bureau of Standards, Cryogenics Division, Boulder, CO
 Semi-Annual Technical Report
 Contract No : ARPA Order-2569
 636 pp., 1975 (AD-A019 230)
Key Words: niobium alloys, titanium alloys, AISI 310, Inconel X-750, Inconel 706, Inconel 718, Incoloy 903, AA 6061, A-286, Invar, Kromarc 58, 21-6-9 steel, tensile properties, fatigue

Miscellaneous Steels

1. **HIPing Effects for Steel's Mechanical Properties**
 Ona, H., Ichikawa, S., Anndou, T., Nishioka, K.
 Elsevier, London, UK
 Proc 3rd Int Conf Hot Isostatic Pressing: Theory Appl 275-80, 1991
Key Words: S45C, tensile properties, hardness, heat treatment

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 Benet Labs, Army Armament Research Development and Engineering Center, Watervliet, NY
 Final Report
 Rept No : ARCCB-TR-88018, 21 pp., 1988 (AD-A196 329)
Key Words: A723, 38644, cylinders, pressure vessels, fracture toughness, fatigue, crack growth, notch fatigue, burst test, aluminum coating

3. **Superplasticity and Hardening of Extremely Fine Grained Ultrahigh Carbon-Chromium-Vanadium-Iron Alloys**
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Key Words: 5Cr steel, 18Cr stainless, forging, atomization, tensile properties, rapid solidification

4. **Dual-Property T63 Turbine Rotor**
 Ewing, B. A., Jain, S. K.
 General Motors Corp., Allison Gas Turbine Operations, Indianapolis, IN
 Final Report Mar 81-Apr 84
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5. **HIP Clad Nickel Base Alloy 625 for Deep Sour Wells**
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 Materials Performance 23 (5), 30-4, 1984 (AD-D129 874)
 Key Words: Inconel 625, AISI 4130, cladding, corrosion, tensile properties,
 dissimilar joining

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 Piske, D., Wittner, I., Seilstorfer, H.
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 Key Words: X 225 CrVMo 13 4, 5Cr steel, Stellite 6, tool steel, porosity,
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 Bishop, R. J., Khare, A. K., Mraz, G. J.
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 Key Words: 3.5Ni steel, fracture mechanics, tensile properties, fracture
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 Audren, H.-O.
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 Key Words: Fe-2.2C-10Co-7Mo-7W-6V-4Cr, martensite, precipitation, tempering,
 microprobe analysis

9. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
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 58 pp., 1978 (AD-A061 867)
 Key Words: Ti-6Al-4V, HY-130, AISI 304, Udimet 700, creep-fatigue, crack
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 Key Words: tool steel, cladding pressure vessels, defects, welding

- 11. Materials Research for Superconducting Machinery-IV**
Reed, R. P., Clark, A. F., Van Reuth, E. C.
National Bureau of Standards, Cryogenics Division, Boulder, CO
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- 12. Development of a Gas Pressure Bonded Four-Pole Alternator Rotor**
Lessmann, G. G., Bryant, W. A.
Westinghouse Astronuclear Lab, Pittsburgh, PA
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Rept No : WANL-M-FR-72-002. 81 pp., 1972 (AD-D101 258)
Key Words: AISI 4340, Inconel 718, welding, bonding, fabrication

NICKEL ALLOYS

IN-100

1. **Fatigue and Creep-Fatigue Deformation of Several Nickel-Base Superalloys at 650 C**
Miner, R., Gayda, J., Maier, R. D.
Metall Trans 13A (10), 1755-65, 1982 (AD-D125 930)
Key Words: Waspaloy, Udimet 700, RENE' 95, IN-100, MERL 76, NASA IIB-7, turbine components, microstructure, creep-fatigue, slip
2. **The Evolution of the Forging Processes on Discs**
Coyne, J. E., Coutts, W. H., Jr.
Kluwer Boston Inc., Hingham, MA
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Key Words: Waspaloy, Inconel 718, IN-100, RENE' 95, MERL 76, Udimet 700, tensile properties, creep rupture, fatigue
3. **Forging and Processing of High-Temperature Alloys**
DeRidder, A. J., Koch, R., ASTM, Philadelphia, PA
Proc Symp MiCon 78 547-63, 1979 (AD-D126 410)
Key Words: RENE' 95, Waspaloy, Inconel 718, IN-100, microstructure, thermomechanical treatment
4. **Original HCl Surface Treatment for Diffusion Bonding of Nickel Superalloy Specimens**
Billard, D., Trottier, J. P., Met Technol 5 (9), 309-19, 1978 (AD-D114 028)
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Inconel 718

1. **Advanced Machining Research Program (AMRP). Volume 4 Laser-Assisted Machining**
Flom, D. G.
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7. **Compositional and Structural Aspects of Processing Nickel-Base Alloys**
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Key Words: Monel 400, Nimonic 75, Nimonic 80A, Nimonic 90, Nimonic 105, Nimonic 115, Nimonic PE13, Inconel 600, Inconel 718, Incoloy 800, Incoloy 825, microstructure, deformation, segregation, grain size

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Rene' 95

1. **The Effect of Loading History on Closure Behavior in RENE' 95**
 Zawada, L.P., Nicholas, T.
 ASTM Committee E-24 on Fracture Testing, Philadelphia, PA
 Proc 18th National Symp Fracture Mechanics ASTM-STP-945
 192-205, 1988 (AD-D143 462)
Key Words: RENE' 95, forging, cyclic loading, fatigue, crack closure

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 Miner, R., Gayda, J., Maier, R. D.
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4. **Aircraft Jet Engine Research Aims at Lighter, Dual-Property Disks**
 Weintraub, P.
 American Metal Market/Metalworking News 87 (167), 10, 13, 1979 (AD-D116 267)
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7. **Material for Advanced Turbine Engines-MATE**
 Bamberger, E. N., Mosier, J. S.
 General Electric Co., Aircraft Engine Group, Evendale, OH
 Fifth Quarterly Engineering Report
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Key Words: RENE' 95, Compressor discs, tensile properties, creep rupture,
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8. **Application of Hot Isostatic Pressing to Aircraft Gas Turbines**
 Evans, D. J.
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Key Words: Udimet 700, RENE' 95, Ti-6Al-4V, turbine components, tensile
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 Bamberger, E. N., Mosier, J. S.
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Key Words: RENE' 95, compressor components, tensile properties, machining,
 aging, heat treatment

Udimet 700

1. **The Influence of Specimen Geometry on Near Threshold Fatigue Crack Growth**
Vecchio, R. S., Crompton, J. S., Hertzberg, R. W.
Fatigue Fract Eng Mater Struct 10 (4), 333-42, 1987 (AD-D137 808)
Key Words: Udimet 700, AA 2024-T3, grain size, crack growth, fatigue crack
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Author Anon
Foreign Technology Division, Wright-Patterson AFB, OH
Rept No : FTD-ID(RS)T-1406-84, 65 pp., 1985 (AD-B093 100L)
Key Words: Ti-6Al-4V, B-1900, IN-738, RENE' 77, IN-792, RENE' 80, AA C355, AA A356, 142-T4
3. **Fatigue and Creep-Fatigue Deformation of Several Nickel-Base Superalloys at 650 C**
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Dermarkar, S., Strudel, J. L.
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Key Words: Udimet 700, cylinders, microstructure, gamma prime, deformation, compressive properties, thermomechanical treatment
6. **Feasibility Study on the use of Small-Angle Neutron Scattering for Microstructural Determinations of Technological Alloys**
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7. **Oxide Dispersion Strengthened Alloys**
Gessinger, G. H.
Applied Sciences Publishers Ltd., London, UK
Proc Conf High Temperature Alloys for Gas Turbines 817-35, 1978 (AD-D116 364)
Key Words: IN-738, IN-738LC, Udimet 700, Nimonic 80A, turbine components, oxide dispersion strengthening, tensile properties, corrosion, thermal fatigue, hardness, grain growth

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Miscellaneous Nickel Alloys

1. **Applications of Coating Technology and HIP to Advanced Materials Processing**
 Nicholls, J. R., Stephenson, D. J.
 Mater High Temp 9 (2), 110-20, 1991
Key Words: nickel, copper, phosphor bronze, Ni-13Al, MAR-M002, AA 7075, AA 8090, silver, Inconel 625, ion plating, electron beam evaporation, coatings, microstructure, creep, diffusion bonding
2. **Hot Isostatic Pressing of PM and Cast Components**
 Stephenson, D. J., Downing, M.
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Key Words: IN-792, IMI 829, IMI 318, IN-738, Alloy 713C, Ti-6Al-4V, nickel, tensile properties, defects, near net shape forming, fatigue, density
3. **Precision Cast vs. Wrought Superalloys**
 Tien, J. K., Borofka, J. C., Casey, M. E.
 J Met 38 (12), 13-7, 1986 (AD-D136 449)
Key Words: nickel alloys, turbine components, crack growth, fatigue vacuum induction, electroslog, electron beam melting
4. **Hot Isostatic Press**
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7. **Effects of Trace Elements of Forgeability of Superalloys**
 Turner, F.
 Met Technol 11 (10), 446-52, 1984 (AD-D131 861)
Key Words: Nimonic 115, Nimonic 75, Nimonic 80, Nimonic 105, Nimonic PK31, plastic deformation, ductility, electron beam melting, vacuum arc melting
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tensile properties, creep rupture, fatigue

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Carlson, D. M.
ASM International, Metals Park, OH
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Key Words: AF-115, turbine components, creep rupture, tensile properties

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16. **Development of a Very High Strength Disk Alloy for 1400F Service**
Dunn, E. L., Bartos, J. L.
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Interim Engineering Progress Report Number Two, Jan-Mar 73
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Key Words: nickel alloys, cobalt addition, chromium addition, development,
creep rupture strength, heat treatment

TITANIUM ALLOYS

Ti-6Al-4V

1. **Hot Isostatic Pressing of PM and Cast Components**
Stephenson, D. J., Downing, M.
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Final Report Jul 79-Aug 83
Rept No : AFWAL-TR-84-4059-Vol-4, 75 pp., 1984 (AD-B087 672L)
Key Words: Inconel 718, Ti-6Al-4V, laser machining, turning, machine tools
4. **Application of Diffusion Welding in the USA**
Weld J 60 (2), 22-33, 1981 (AD-D120 554)
Owczarski, W. A. Paulonis, D. F.
Key Words: Pyromet X-15, T-111, Ti-6Al-4V, diffusion welding, bonding, dissimilar joining
5. **Energy Efficient Engine Shroudless, Hollow Fan Blade Technology Report**
Michael, C. J.
Pratt and Whitney Aircraft Group, Commercial Products Div, East Hartford, CT
Contractor Report
Rept No : NASA-CR-165586, 83 pp., 1981 (AD-D125 625)
Key Words: Ti-6Al-4V, turbofan engine, fan blades, superplastic forming, diffusion bonding, tensile properties, fatigue
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Broichhausen, J., Telfah, M.
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Proc 4th Int Conf Titanium, Titanium '80-Science and Technology
3, 1797-1806, 1980 (AD-D121 214)
Key Words: Ti-6Al-4V, fatigue, surface roughness, microhardness
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Messler, R. W., Jr., Pacz, C. A.
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Rept No : A82-23757, 16 pp., 1980 (AD-D126 682)
Key Words: Ti-6Al-4V, Ti-6Al-4V-2Sn, aircraft structures, welding, diffusion bonding, superplastic forming, net shape forming

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Highberger, W. T.
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Key Words: Ti-6Al-6V-2Sn, Ti-6Al-4V, Corona-5, Ti-4.5Al-5Mo-1.5Cr, aircraft structures, net shape forming, superplastic forming, diffusion bonding
9. **Metallforming's Big Push to Systems Technologies**
Larsen, R. J., Harvey, R. E., Post, C. T., Weimer, G. A., LeCret, B. H.
Iron Age 222 (43), 53-63, 1979 (AD-D116 917)
Key Words: Ti-6Al-4V, copper, aluminum, stainless steel, superplastic forming, diffusion bonding
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